



Archaeological Resources

Airport Vicinity Development Checklist

Parking Study

Trip Generation Comparison

Parking Master Plan



TRAFFIC IMPACT ANALYSIS

SWC 99th Place
and McDowell Mountain Ranch Road
Scottsdale, Arizona

Prepared for:
SCW Holdings, LLP

Kimley»Horn

TRAFFIC IMPACT ANALYSIS

SWC 99th Place and McDowell Mountain Ranch Road Scottsdale, Arizona

Prepared for:

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1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION

This report documents a traffic impact analysis performed for a proposed senior living facility located on the south side of McDowell Mountain Ranch Road at 99th Place in Scottsdale, Arizona. The site will include assisted living and congregate care facility land uses and is anticipated to be built out by 2021.

1.2 REPORT PURPOSE AND OBJECTIVES

Kimley-Horn and Associates, Inc., has been retained by SCW Holdings, LLP to perform the traffic impact analysis for the proposed development.

The purpose of this study is to address traffic and transportation impacts of the proposed development on surrounding streets and intersections. This traffic analysis was prepared based on criteria set forth by the City of Scottsdale Transportation Impact and Mitigation Analysis, Category II. The specific objectives of this study are:

- To evaluate lane requirements on all existing roadway links and at all existing intersections within the study area;
- To determine future level of service (LOS) for all existing intersections within the study area and recommend any capacity-related improvements;
- To determine necessary lane configurations at all new driveways within the proposed development in order to provide acceptable future levels of service;
- To evaluate the need for auxiliary lanes at all study area intersections; and
- To evaluate the need for future traffic signals.

1.3 PRINCIPAL FINDINGS AND RECOMMENDATIONS

The proposed development is expected to generate 340 daily trips, with 14 trips occurring in the AM peak hour and 31 trips occurring in the PM peak hour. To ensure that the estimate of the traffic impacts is the maximum that can be expected, it is assumed that the site will be 100 percent occupied upon buildout in 2021.

- The signalized intersection of Thompson Peak Parkway and McDowell Mountain Ranch Road is expected to operate at an acceptable level of service in 2021, with the exception of the southbound left-turn lane and the eastbound thru lane in the PM peak period.
- The unsignalized intersection of 98th Street and McDowell Mountain Ranch Road and the site driveways are expected to operate at an acceptable level of service in 2021.
- It is recommended that a continuous two-way left-turn lane be striped to provide access for the left turning movements into the site driveways and to maintain access to the existing private streets on the north side of McDowell Mountain Ranch Road.

- It is recommended that sight triangles be provided at all site access points to give drivers exiting the site a clear view of oncoming traffic. The landscaping within sight triangles must not obstruct drivers' views of the adjacent travel lanes. Sight distance should be provided at all street intersections and where driveways intersect with streets per Section 5-3.123 Part D of City of Scottsdale Design Standards & Policies Manual.

2.0 PROPOSED DEVELOPMENT

2.1 SITE LOCATION

The proposed development, a senior care facility, is located on the south side of McDowell Mountain Ranch Road at 99th Place in Scottsdale, Arizona. The project location is shown in **Figure 1**.

2.2 LAND USE AND SITE PLAN

The overall development consists of an assisted living and congregate care facility. The total site area is on approximately 5.3-acres±. **Table 1** illustrates the land use of the proposed development.

Table 1. Land Use

General Description	ITE Land Use	Size
Congregate Care Facility	253	139 DU's
Assisted Living	254	22 Beds

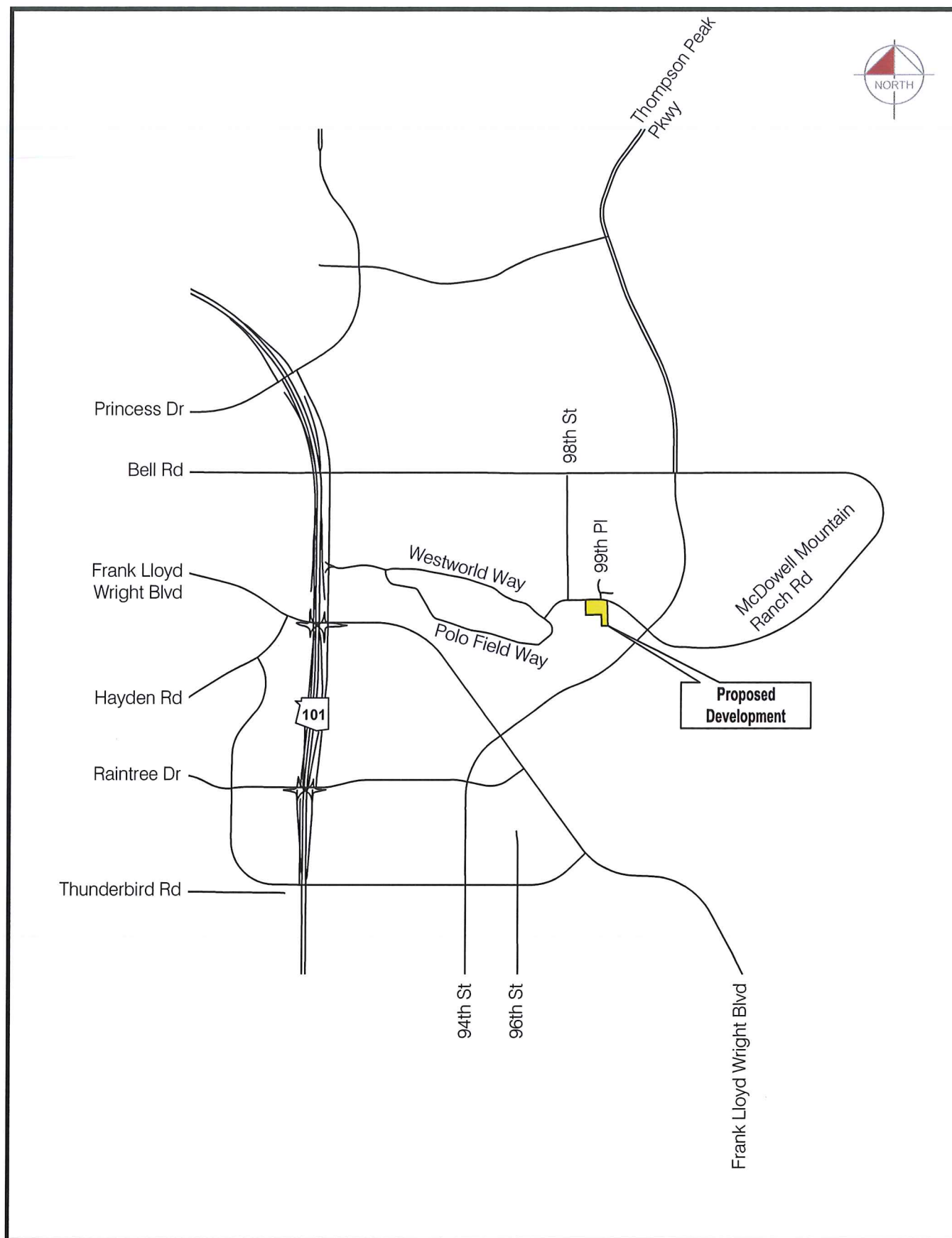
The layout of the site is illustrated in **Figure 2**.

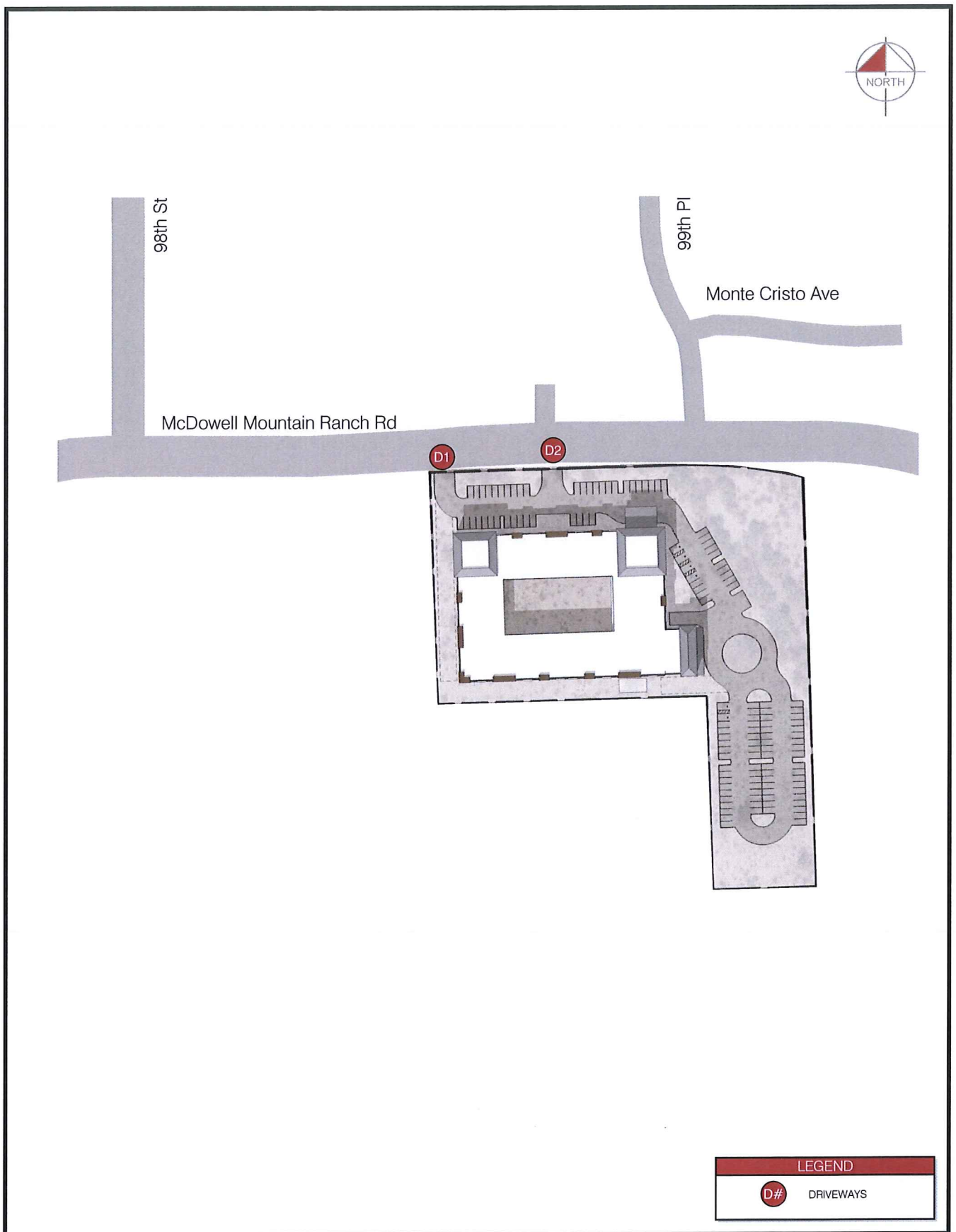
2.3 SITE ACCESSIBILITY

The site is accessed locally via McDowell Mountain Ranch Road. Regional access is expected to be provided by the Pima Freeway (Loop 101) and by the other arterial streets in the vicinity such as Thompson Peak Parkway, Bell Road and Frank Lloyd Wright Boulevard.

2.4 SITE CIRCULATION

The site plan is shown in previously referenced **Figure 2**. The site consists of two full access driveways. Driveway D1 is located approximately 470 feet east of 98th Street on the south side of McDowell Mountain Ranch Road. Driveway D2 aligns with an existing driveway on the north side of McDowell Mountain Ranch Road. Driveway D2 is approximately 150 feet east of Driveway D1 and approximately 620 feet east of 98th Street on the south side of McDowell Mountain Ranch Road.





3.0 STUDY AREA

3.1 STUDY AREA

The study area includes the intersection of McDowell Mountain Ranch Road with 98th Street and Thompson Peak Parkway as well as the site driveways along McDowell Mountain Ranch Road.

3.2 ADJACENT LAND USE

The area in the vicinity of the site contains a mix of land uses that is primarily comprised of residential, recreation uses, a high school and middle school, commercial and office land uses. Single-family residential housing exists north and northeast of the site. A new condominium residential development is currently under construction on the northeast corner of 98th Street and McDowell Mountain Ranch Road. The driveway on the east side of the condominium development aligns with Driveway D2. West World of Scottsdale is located approximately a quarter mile west of the site. Notre Dame Preparatory High School is located on the southwest corner of 98th Street and Bell Road, northwest of the site. The Desert Canyon Middle School is located south of the intersection of McDowell Mountain Ranch Road and 102nd Place, southeast of the site. A business park, is located northwest of the site, bounded by the Pima Access Road to the west, Bell Road to the north, 94th Street to the east and West World Way to the south

The Loop 101 is located approximately 1.5 miles west of the site.

4.0 EXISTING CONDITIONS

4.1 PHYSICAL CHARACTERISTICS

The existing roadway network within the study area includes McDowell Mountain Ranch Road, Thompson Peak Parkway, and 98th Street. The existing intersection lane use and traffic control is shown in **Figure 3**.

McDowell Mountain Ranch Road currently extends east-west with two lanes in each direction with a two-way left turn lane in the vicinity of the site. Curb, gutter and sidewalk are in place on the north side of the roadway in the vicinity of the site. The posted speed limit is 30 mph. The City of Scottsdale classifies McDowell Mountain Ranch Road as a major collector roadway west of Thompson Peak Parkway and a minor arterial roadway east of Thompson Peak Parkway.

Thompson Peak Parkway currently extends northeast-southwest in the vicinity of site with two lanes in each direction with a raised median. Curb, gutter and sidewalk are in place on both sides of the roadway in the vicinity of the site. The posted speed limit is 45 mph. The City of Scottsdale classifies Thompson Peak Parkway as a minor arterial roadway.

98th Street currently extends north-south with one lane in each direction in the vicinity of the site. Curb, gutter, and sidewalk exist on the east side of 98th Street in the vicinity of the site. The posted speed limit is 35 mph. The City of Scottsdale classifies 98th Street as a major collector roadway.

The existing intersections analyzed in this report are Thompson Peak Parkway/McDowell Mountain Ranch Road (signalized), with protected left-turn phasing in all directions, and 98th Street/ McDowell Mountain Ranch Road (stop-controlled in the southbound direction).

4.2 TRAFFIC VOLUMES

Turning movement counts were collected at the intersections of Thompson Peak Parkway/McDowell Mountain Ranch Road and 98th Street/ McDowell Mountain Ranch Road on Thursday, April 11, 2019. The counts were performed between 7:00 AM and 9:00 AM and between 4:00 PM and 6:00 PM. The results of these counts are shown in **Figure 3**. A copy of the counts is attached in the **Appendix**.

4.3 LEVEL OF SERVICE

The LOS at the intersections of McDowell Mountain Ranch Road with Thompson Peak Parkway and 98th Street were evaluated using the traffic counts collected on Thursday, April 11, 2019. The LOS for the intersections were evaluated using the *Highway Capacity Manual 6th Edition* methodology for unsignalized intersections and *Synchro 10* methodology for the signalized intersection with signal timing information provided by the City of Scottsdale. The existing intersection geometry and control, shown in **Figure 3**, was used to obtain the LOS. The results of this analysis are shown in **Table 2** and **Table 3**. LOS worksheets and signal timing assumptions are included in the **Appendix**.

Table 2. Existing Level of Service: Unsignalized Intersection

Intersection	NB			SB			EB			WB		
	L	T	R	L	T	R	L	T	R	L	T	R
98th Street and McDowell Mountain Ranch Road												
AM Peak	-			B			A	-	-	-	-	-
PM Peak	-			B			A	-	-	-	-	-

The unsignalized intersection operates at an acceptable LOS.

Table 3. Existing Level of Service: Signalized Intersection

Intersection	NB			SB			EB			WB			Intersection LOS
	L	T	R	L	T	R	L	T	R	L	T	R	
Thompson Peak Parkway and McDowell Mountain Ranch Road													
AM Peak	D	C	A	D	D	A	D	D	B	D	C	A	C
PM Peak	D	C	A	E	D	A	D	E	B	D	C	A	C

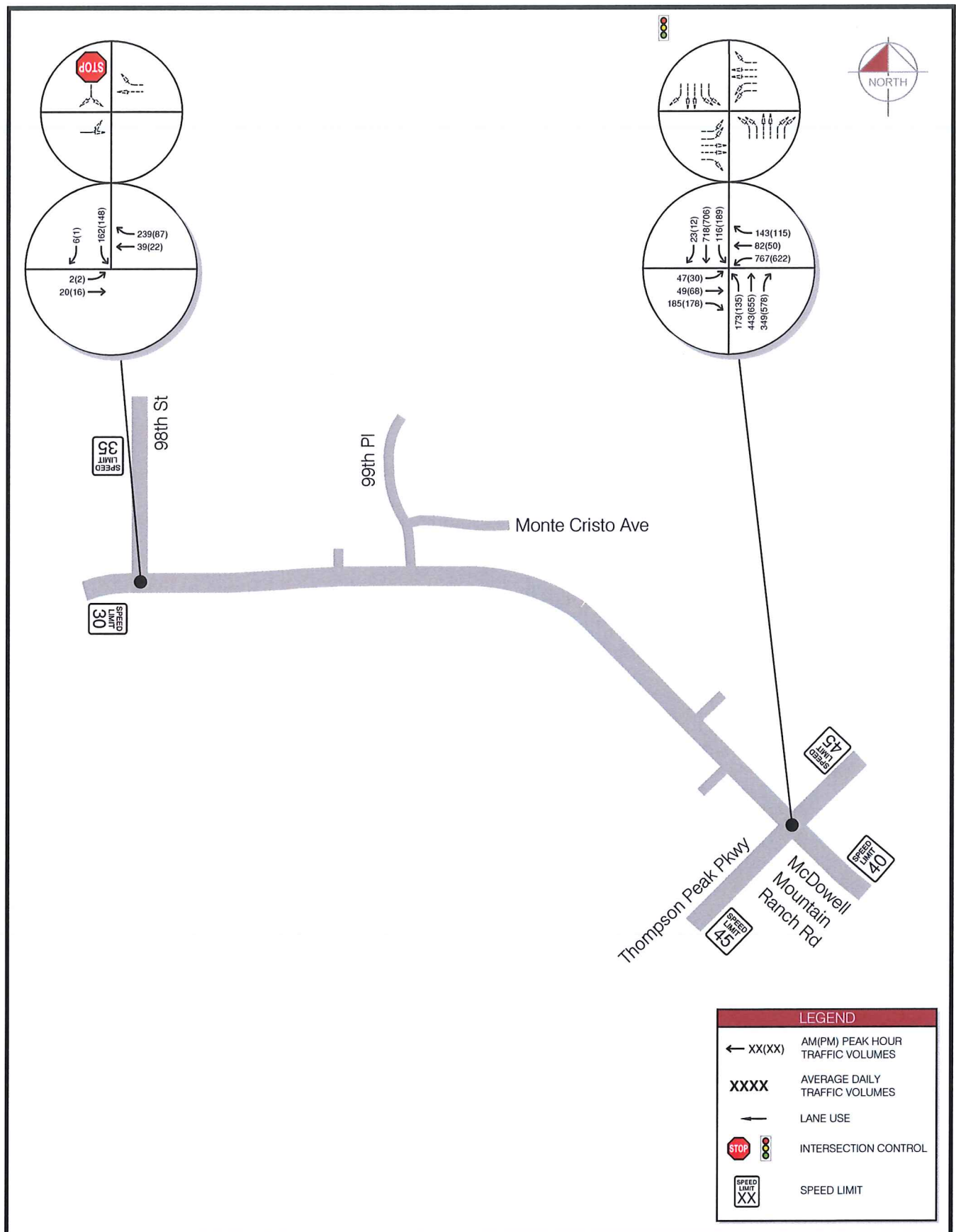
The signalized intersection operates at an acceptable level of service with the exception of the southbound left-turn and the eastbound thru movement in the PM peak period.

4.4 CRASH DATA

Crash data at the intersection of McDowell Mountain Ranch Road with Thompson Peak Parkway and 98th Street was obtained from the City of Scottsdale from January 2013 to October 2018. The crash data is included in the **Appendix**.

Based on the crash data obtained from the City of Scottsdale, there were 46 crashes reported at the intersection of McDowell Mountain Ranch Road and Thompson Peak Parkway over the five year period. There were two non-incapacitating injuries. One non-incapacitating injury crash was a rear end crash (front to rear) and one front to side angle crash. One single vehicle possible injury crash occurred, and two other single vehicle crashes occurred with no injury. The remaining crashes were noninjury crashes. There were eleven front to side non-left turn angle crashes, four left turn crashes, 15 front to rear crashes, two head-on crashes, seven same direction sideswipe crashes, one opposite direction sideswipe crashes, and one rear-to-side crashes. The intersection of McDowell Mountain Ranch Road and Thompson Peak Parkway ranks 102 out of 202 intersections based on the number of collisions occurring at the intersection. The average collision rate in Scottsdale is 0.65 collisions per million vehicles. The intersection of McDowell Mountain Ranch Road and Thompson Peak Parkway has a collision rate less than the average of 0.55 collisions per million vehicles entering the intersection.

There were three crashes reported at the intersection of 98th Street and McDowell Mountain Ranch Road over the five year period. One possible injury crash occurred from a rear end, front to rear crash. There were two noninjury left turn crashes.



5.0 PROJECTED TRAFFIC

5.1 SITE TRAFFIC FORECASTS

5.1.1 TRIP GENERATION

The Institute of Transportation Engineers' (ITE) *Trip Generation, 10th Edition*, was used to obtain daily and peak-hour trip generation rates and inbound-outbound percentages, which were then used to estimate the number of daily and peak hour trips that can be attributed to the proposed development. The trip generation characteristics of the site are summarized in **Table 4**.

Table 4. Project Trip Generation

Land Use	ITE Code	Quantity	Units	Daily Total	AM Peak			PM Peak		
					In	Out	Total	In	Out	Total
Congregate Care Facility	253	139	DUs	282	6	4	10	13	12	25
Assisted Living	254	22	Bed(s)	58	3	1	4	2	4	6
Total Trips				340	9	5	14	15	16	31

The proposed development is expected to generate 340 daily trips, with 14 trips occurring in the AM peak hour and 31 trips occurring in the PM peak hour.

Under the existing zoning, six single-family dwelling units could be developed. A trip generation comparison of a potential land use under the existing zoning and the proposed development under the new zoning is summarized in **Table 5**.

Table 5. Trip Generation Zoning Comparison

Land Use	ITE Code	Quantity	Units	Daily Total	AM Peak			PM Peak		
					In	Out	Total	In	Out	Total
Single-Family Detached Housing	210	6	DUs	58	1	3	4	4	2	6

The calculation indicates that the proposed land use may increase daily trips by as much as 282 trips. During the AM peak period, the proposed development may increase trip generation by 10 trips, during the PM peak period, the trip generation may increase by 25 trips when compared to an existing potential use for the site.

Under the City of Scottsdale General Plan, office land use is planned for this site. Office square footage was determined based on a floor area ratio of 0.25 and the approximate total site area of 5.3 acres. It was calculated that a 58,021 square foot office building could be constructed on the proposed site. A trip generation comparison of a potential land use within the City of Scottsdale General Plan and the proposed development under the new zoning is summarized in **Table 6**.

Table 6. Trip Generation General Plan Comparison

Land Use	ITE Code	Quantity	Units	Daily Total	AM Peak			PM Peak		
					In	Out	Total	In	Out	Total
General Office Building	710	58,021	1,000 Sq Ft	566	58	9	67	11	56	67

The calculation indicates that the proposed land use may decrease daily trips by as much as 226 trips. During the AM peak period, the proposed development may decrease trip generation by 53 trips, during the PM peak period, the trip generation may decrease by 36 trips when compared to the City of Scottsdale's General Plan potential use for the site.

5.1.2 TRIP DISTRIBUTION

Daily trips were distributed based on the Maricopa Association of Governments' (MAG) estimate of total households within a 11.8-mile radius of the site and distributed over the cardinal directions. This radius is based on the average employment trip length as reported from the 2009 National Household Travel Survey (NHTS).

<u>Percent to and from:</u>	<u>2015</u>	<u>2040</u>
North	10 %	13 %
East	7 %	7 %
South	33 %	29 %
West	50 %	51 %

The results of this distribution are used as a basis for determining the ultimate trip distribution for the site. In addition to the MAG projected residential distribution, the ultimate surrounding roadway system also is taken into consideration when trip distribution is determined; therefore, the distribution shown above was further refined by considering the future roadway network near the site. **Figure 4** illustrates the trip distribution for the study area.

5.1.3 TRAFFIC ASSIGNMENT

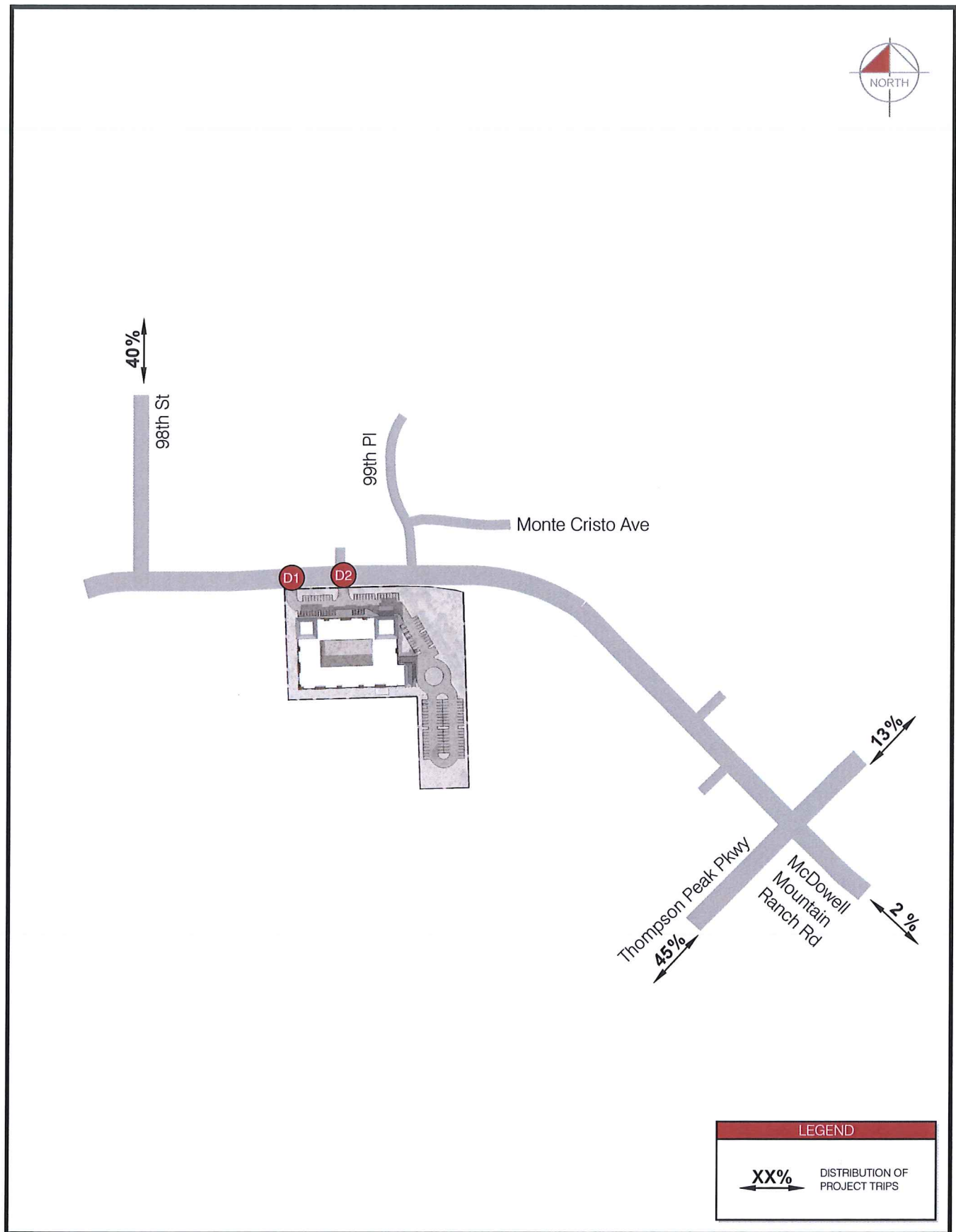
Trips generated by the proposed development were assigned to the roadway network on the basis of the trip distribution and the likely travel patterns to and from the site. **Figure 5** shows the results of the traffic assignment.

5.2 FUTURE TRAFFIC FORECASTING

The area in the vicinity of the site is generally developed and additional growth in the surrounding area that would significantly contribute to the street system traffic volumes is not expected.

5.3 TOTAL TRAFFIC

The results of the traffic assignment were added to the existing traffic volumes shown in **Figure 3** to produce total traffic volumes for the study area. These total traffic volumes are shown in **Figure 6**.



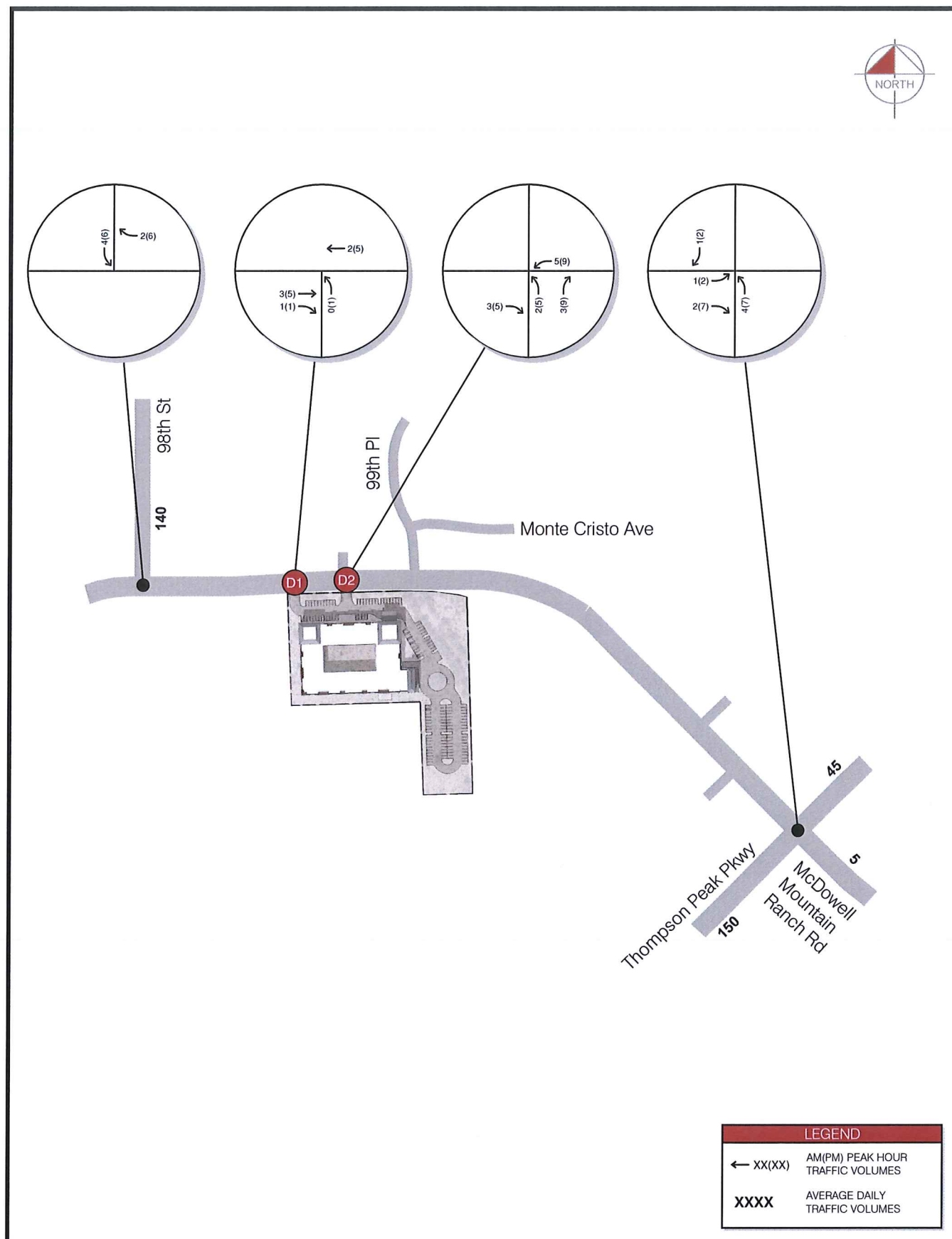


Figure 5
Site Traffic Assignment

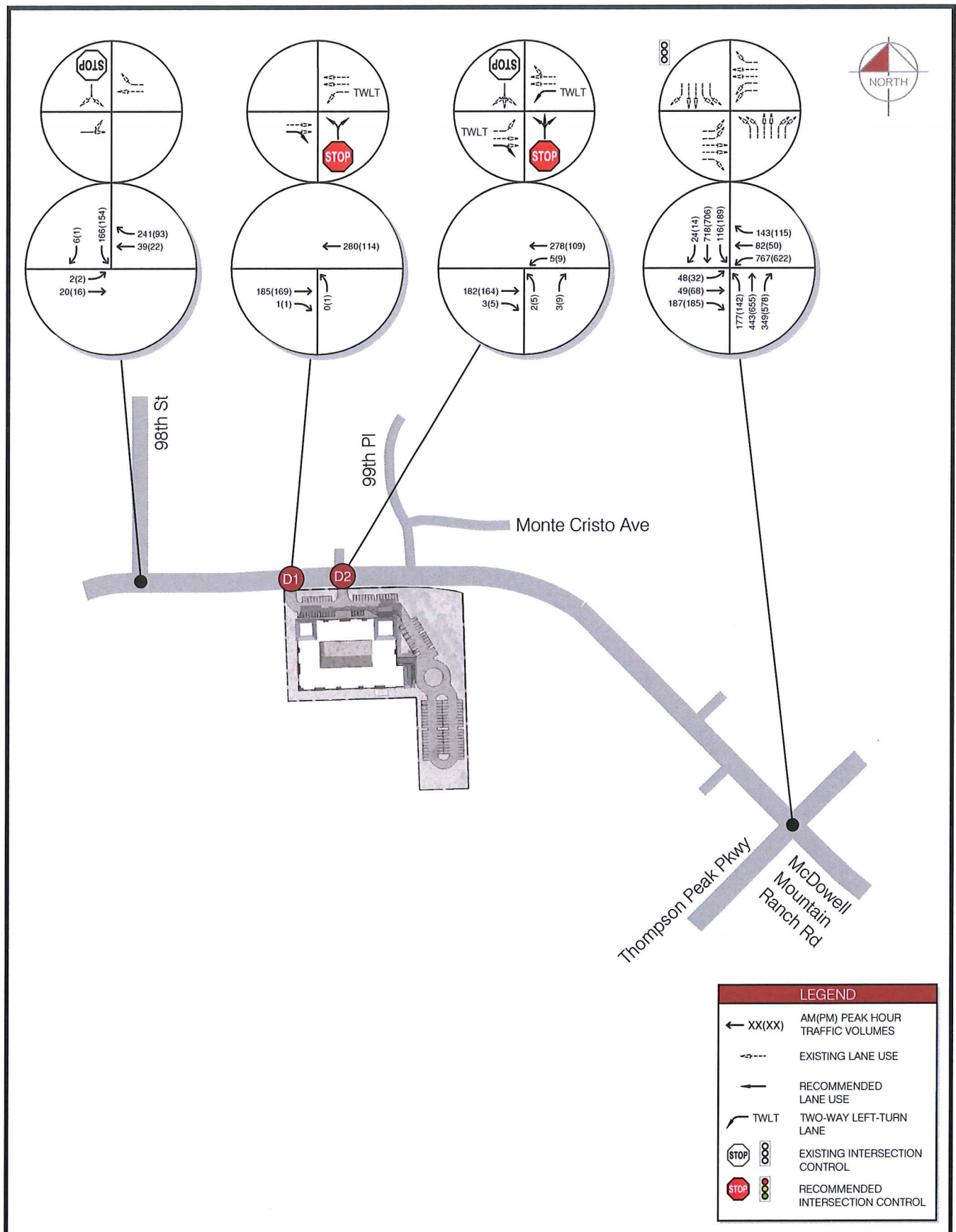


Figure 6
2021 Total Traffic

6.0 TRAFFIC AND IMPROVEMENT ANALYSIS

6.1 LEVEL OF SERVICE ANALYSIS

The LOS for the study area intersections for 2021 were evaluated using the *Highway Capacity Manual 6th Edition* methodology for unsignalized intersections and *Synchro 10* methodology for the signalized intersection with signal timing information provided by the City of Scottsdale. LOS analysis worksheets and signal timing assumptions are included in the **Appendix**.

6.1.1 2021 TOTAL TRAFFIC LEVEL OF SERVICE ANALYSIS

The unsignalized intersection in the study area was evaluated on the basis of the 2021 total traffic and the recommended geometry shown in **Figure 6**. The results of the analysis for the unsignalized intersections and site driveways are shown in **Table 7**.

Table 7. 2021 Total Traffic Level of Service: Unsignalized Intersections

Intersection	NB			SB			EB			WB		
	L	T	R	L	T	R	L	T	R	L	T	R
98th Street and McDowell Mountain Ranch Road												
AM Peak	-			B			A	-	-	-	-	-
PM Peak	-			B			A	-	-	-	-	-
Driveway D1 and McDowell Mountain Ranch Road												
AM Peak	-			-			-			-	-	-
PM Peak	B			-			-			-	-	-
Driveway D2 and McDowell Mountain Ranch Road												
AM Peak	A			-	-	-	-	-		A		-
PM Peak	A			-	-	-	-	-		A		-

The unsignalized intersections and site driveways are expected to operate at a satisfactory LOS in 2021.

The signalized intersection in the study area was evaluated on the basis of the 2021 total traffic and the recommended geometry shown in **Figure 6**. The results of this analysis are shown in **Table 8**.

Table 8. 2021 Total Traffic Level of Service: Signalized Intersection

Intersection	NB			SB			EB			WB			Intersection LOS
	L	T	R	L	T	R	L	T	R	L	T	R	
Thompson Peak Parkway and McDowell Mountain Ranch Road													
AM Peak	D	C	A	D	D	A	D	D	B	D	C	A	C
PM Peak	D	C	A	E	D	A	D	E	B	D	C	A	C

The signalized intersections' operation conclusions are the same as the existing traffic condition.

6.2 LEFT-TURN STORAGE ANALYSIS

The signalized and unsignalized intersections in the study area were analyzed to determine the left-turn storage needed to accommodate the expected traffic volumes in the year 2021.

The left-turn storage lengths were determined for the left-turn movements at the study area intersections. The calculations associated with these conclusions are included in the **Appendix**. The recommended storage lengths are based on total traffic volumes shown in **Figure 6**.

Table 9. Left Turn Storage

Intersection and Approach	Existing	Recommended
Thompson Peak Parkway and McDowell Mountain Ranch Road		
- Northbound Approach	225 feet	225 feet*
- Southbound Approach	260 feet	260 feet*
- Eastbound Approach	300 feet	300 feet*
- Westbound Approach	250 feet	250 feet**
Driveway D1 and McDowell Mountain Ranch Road		
- Westbound Approach	-	TWLT
Driveway D2 and McDowell Mountain Ranch Road		
- Westbound Approach	-	TWLT

*Calculated value less than existing.

**Storage is not impacted by the development. No mitigation recommended.

TWLT = Two-way left-turn

It is recommended that the westbound approach to the intersection of Driveway D2 and McDowell Mountain Ranch Road be restriped to provide a two-way left-turn lane which also allows access to the existing private street on the north side of McDowell Mountain Ranch Road.

6.3 RIGHT-TURN LANES

Right-turn lanes are often recommended on roadways where right-turning vehicles create delays or safety problems for other traffic movements. The need for a right-turn lane depends on the speed of traffic on the road, the volume of traffic turning right, and the through traffic volume in the same lane as the right-turning traffic.

6.3.1 INTERSECTIONS

Right turn lanes are in place on all approaches to the intersections of McDowell Mountain Ranch Road and Thompson Peak Parkway. A dedicated westbound right turn drop lane is in place at the intersection of McDowell Mountain Ranch Road and 98th Street.

Site traffic will not significantly impact the right turn storage at the intersection of Thompson Peak Parkway and McDowell Mountain Ranch Road, therefore, no modifications are recommended at the intersection.

6.3.2 DRIVEWAY

The City of Scottsdale recommends a right-turn deceleration lane at site driveways when the following criteria is met:

- At least 5,000 vehicles per day are expected to use the street;

- The 85th percentile traffic speed on the street is at least 35 miles per hour;
- At least 30 vehicles will make right turns into the driveway during a one hour period.

Review of total traffic under the buildout condition in previously referenced **Figure 6** reveals that the site driveways do not meet the criteria for the installation of a right-turn deceleration lane for the eastbound right turn lanes at the intersections of McDowell Mountain Ranch Road with Driveway D1 and D2.

6.4 DRIVEWAY CRITERIA

The site driveways satisfy the City of Scottsdale minimum driveway spacing requirement of 150 feet for driveways along major collector roadways.

6.5 SITE CIRCULATION

In order to provide smooth ingress and egress to the proposed development, all site driveways should be constructed with appropriate throat lengths. Provision of sufficient throat lengths at all site driveways will prevent entering vehicles from obstructing traffic flow on the adjacent public street system and provide adequate on-site storage for exiting vehicles. Based on queuing analysis for unsignalized intersections, the proposed site driveways provide sufficient on-site storage lengths to accommodate the anticipated future queue length at the proposed site access driveways.

6.6 SIGHT TRIANGLES

It is recommended that sight triangles be provided at all site access points to give drivers exiting the site a clear view of oncoming traffic. The landscaping within sight triangles must not obstruct drivers' views of the adjacent travel lanes. Sight distance should be provided at all street intersections and where driveways intersect with streets per Section 5-3.123 Part D of City of Scottsdale Design Standards & Policies Manual.

7.0 CONCLUSIONS AND RECOMMENDATIONS

The proposed development is expected to generate 340 daily trips, with 14 trips occurring in the AM peak hour and 31 trips occurring in the PM peak hour. To ensure that the estimate of the traffic impacts is the maximum that can be expected, it is assumed that the site will be 100 percent occupied upon buildout in 2021.

The signalized intersection of Thompson Peak Parkway and McDowell Mountain Ranch Road is expected to operate at an acceptable level of service in 2021, with the exception of the southbound left-turn lane and the eastbound thru lane in the PM peak period.

The unsignalized intersection of 98th Street and McDowell Mountain Ranch Road and the site driveways are expected to operate at an acceptable level of service in 2021.

It is recommended that a continuous two-way left-turn lane be striped to provide access for the left turning movements into the site driveways and to maintain access to the existing private streets on the north side of McDowell Mountain Ranch Road.

It is recommended that sight triangles be provided at all site access points to give drivers exiting the site a clear view of oncoming traffic. The landscaping within sight triangles must not obstruct drivers' views of the adjacent travel lanes. Sight distance should be provided at all street intersections and where driveways intersect with streets per Section 5-3.123 Part D of City of Scottsdale Design Standards & Policies Manual.

APPENDIX

- Traffic Counts
- Signal Timing Information
- Trip Generation Calculations
- Existing AM Traffic Capacity Analysis
- Existing PM Traffic Capacity Analysis
- 2021 Total AM Traffic Capacity Analysis
- 2021 Total PM Traffic Capacity Analysis
- Left Turn Storage Calculations
- City of Scottsdale Standards

Traffic Counts

Intersection Turning Movement

Prepared by:



FIELD DATA SERVICES OF ARIZONA, INC.
520.316.6745

Project #: 19-1198-001

TMC SUMMARY OF 98th St. & McDowell Mtn. Ranch Rd.

98th St.

McDowell Mtn. Ranch Rd.

APPROACH LANES				
TOTAL		7	0	310
PM	1	0	148	
MD				
AM	6	0	162	

N

McDowell Mtn. Ranch Rd.

TOTAL	AM	MD	PM
4	2		2
36	20		16
0	0		0

CONTROL

1-Way Stop

SB

AM	MD	PM	TOTAL
239		87	326
39		22	61
0		0	0

98th St.

TOTAL	AM	MD	PM
0	0	0	0
0	0	0	0
0	0	0	0

APPROACH LANES

LOCATION #: 19-1198-001

TURNING MOVEMENT COUNT

98th St. & McDowell Mtn. Ranch Rd.
(Intersection Name)

THURSDAY
Day

04/11/19
Date

COUNT PERIODS	
AM	700AM - 900AM
NOON	-
PM	400PM - 600PM

AM PEAK HOUR

700 AM

NOON PEAK HOUR

PM PEAK HOUR

500 PM

Intersection Turning Movement Prepared by:



Project #: 19-1198-002

TMC SUMMARY OF Thompson Peak Pkwy. & McDowell Mtn. Ranch Rd.

Thompson Peak Pkwy.

APPROACH LANES

TOTAL	35	1424	305
PM	12	706	189
MD			
AM	23	718	116

McDowell Mtn. Ranch Rd.

CONTROL
Signal

Thompson Peak Pkwy.

APPROACH LANES

TOTAL	135	655	578
PM			
MD			
AM	173	443	349
TOTAL	308	1098	927

McDowell Mtn. Ranch Rd.

Thompson Peak Pkwy.

APPROACH LANES

TOTAL	77	47	30
PM			
MD			
AM	117	49	68
TOTAL	363	185	178

McDowell Mtn. Ranch Rd.

LOCATION #: 19-1198-002

TURNING MOVEMENT COUNT

Thompson Peak Pkwy. & McDowell Mtn. Ranch Rd.
(Intersection Name)

THURSDAY **04/11/19**
Day Date

COUNT PERIODS	
AM	700AM - 900AM
NOON	-
PM	400PM - 600PM

AM PEAK HOUR

715 AM

NOON PEAK HOUR

PM PEAK HOUR

445 PM

Signal Timing Information



THOMPSON PK & McDOWELL MT. RANCH

COORDINATOR PATTERNS

	PH1	2	3	4	5	6	7	8	SYSTEM #
FDW	26	0	34	0	26	0	34	0	234
YELLOW	4.7	3.0	4.0	0.0	4.7	3.0	4.0	0.0	SECTION #
ALL RED	2.3	2.0	4.0	0.0	2.3	2.0	4.0	0.0	101

MORNING	EVENING	N/S	EX
MID-DAY	MIDNIGHT	E/W	EX
CLEARANCE	BASIC TIME	SEQUENCE	HISTORY

MM-3-3 MORNING SPLIT PATTERNS

TIMING PLAN # 1		SEQUENCE	
SEQUENCE # 3		R1	1 ↑ 2 ↘ 3 ←
ACTION PLAN #		R2	5 ↓ 6 ↙ 7 →
MOVEMENTS	NBT SBL WBT	SBT NBL EBT	

WALK & GREEN	W/S
FDW & GREEN	
GREEN	
w/o WALK	
LEFT	

PLAN # 1
DATE EFFECTIVE
11/15/2002
OPERATIVE TIMES
0630-0900
use seq 3



PHASE	1	2	3	4	5	6	7	8	TARGET
SPLIT	28	12	36	19	25	15	19	36	95
COORD	x				x				
RECALLS (V, P, Mx)	v				v				
GREEN	21	7	28	19	18	10	11	36	



MM-3-2 AVAILABLE COORDINATOR PATTERN #s

1 1
1 2
1 3
1 4
1 5
1 6
2 1
2 2
2 3
2 4
2 5
2 6

PROGRESSION VALUES

DIR CODE	COORD DIR	B.O.G. OFFSET
1	NB	85
2	SB	85
3	NS	85
4	EB	0
5	WB	0
6	EW	0

HYPERLINKS
TO MORNING
TIME-SPACE
DIAGRAMS



PLAN # 2
DATE EFFECTIVE
3/30/2009
OPERATIVE TIMES
use seq 3



PHASE	1	2	3	4	5	6	7	8	TARGET
SPLIT	32	12	34	17	29	15	17	34	95
COORD	x				x				
RECALLS (V, P, Mx)	v				v				
GREEN	25	7	26	17	22	10	9	34	



PLAN # 3
DATE EFFECTIVE
3/30/2009
OPERATIVE TIMES
use seq 7



PHASE	1	2	3	4	5	6	7	8	TARGET
SPLIT	39	11	44	15	26	24	15	44	109
COORD	x				x				
RECALLS (V, P, Mx)	v				v				
GREEN	32	6	36	15	19	19	7	44	





THOMPSON PK & McDOWELL MT. RANCH

COORDINATOR PATTERNS

	PH1	2	3	4	5	6	7	8	SYSTEM #
FDW	26	0	34	0	26	0	34	0	234
YELLOW	4.7	3.0	4.0	0.0	4.7	3.0	4.0	0.0	SECTION #
ALL RED	2.3	2.0	4.0	0.0	2.3	2.0	4.0	0.0	101

MORNING	EVENING	N/S	EX
MID-DAY	MIDNIGHT	E/W	EX
CLEARANCE	BASIC TIME	SEQUENCE	HISTORY

MM-3-3 MID-DAY SPLIT PATTERNS

PLAN # 4
DATE EFFECTIVE
11/15/2002
OPERATIVE TIMES
use seq 3
1830-2100

TIMING PLAN 1
SEQUENCE 3
ACTION PLAN

MOVEMENTS
NBT SBL WBT
SBT NBL EBT

SEQUENCE
R1 1 ↑ 2 ↘ 3 ←
R2 5 ↓ 6 ↙ 7 →

LEGEND
WALK & GREEN
FDW & GREEN
GREEN
w/o WALK
LEFT

PHASE	1	2	3	4	5	6	7	8	TARGET
SPLIT	28	12	36	19	25	15	19	36	95
COORD	X				X				
RECALLS (V, P, Mx)	V				V				
GREEN	21	7	28	19	18	10	11	36	

ACTUAL CYCLE
RING 1
RING 2

PLAN # 5
DATE EFFECTIVE
3/30/2009
OPERATIVE TIMES
as needed

TIMING PLAN 1
SEQUENCE 3
ACTION PLAN

MOVEMENTS
NBT SBL WBT
SBT NBL EBT

SEQUENCE
R1 1 ↑ 2 ↘ 3 ←
R2 5 ↓ 6 ↙ 7 →

LEGEND
WALK & GREEN
FDW & GREEN
GREEN
w/o WALK
LEFT

PHASE	1	2	3	4	5	6	7	8	TARGET
SPLIT	32	12	34	17	29	15	17	34	95
COORD	X				X				
RECALLS (V, P, Mx)	V				V				
GREEN	25	7	26	17	22	10	9	34	

ACTUAL CYCLE
RING 1
RING 2

PLAN # 6
DATE EFFECTIVE
3/30/2009
OPERATIVE TIMES
use seq 3

TIMING PLAN 1
SEQUENCE 3
ACTION PLAN

MOVEMENTS
NBT SBL WBT
SBT NBL EBT

SEQUENCE
R1 1 ↑ 2 ↘ 3 ←
R2 5 ↓ 6 ↙ 7 →

LEGEND
WALK & GREEN
FDW & GREEN
GREEN
w/o WALK
LEFT

PHASE	1	2	3	4	5	6	7	8	TARGET
SPLIT	28	11	23	13	26	13	13	23	75
COORD	X				X				
RECALLS (V, P, Mx)	V				V				
GREEN	21	6	15	13	19	8	5	23	

ACTUAL CYCLE
RING 1
RING 2

MM-3-2 AVAILABLE COORDINATOR PATTERN #s

4 1
4 2
4 3
4 4
4 5
4 6
5 1
5 2
5 3
5 4
5 5
5 6
6 1
6 2
6 3
6 4
6 5
6 6

PROGRESSION VALUES

DIR CODE	COORD DIR	B.O.G. OFFSET
1	NB	85
2	SB	85
3	NS	85
4	EB	0
5	WB	0
6	EW	0

HYPERLINKS TO MID-DAY TIME-SPACE DIAGRAMS





THOMPSON PK & McDOWELL MT. RANCH

COORDINATOR PATTERNS

	PH1	2	3	4	5	6	7	8	SYSTEM #
FDW	26	0	34	0	26	0	34	0	234
YELLOW	4.7	3.0	4.0	0.0	4.7	3.0	4.0	0.0	SECTION #
ALL RED	2.3	2.0	4.0	0.0	2.3	2.0	4.0	0.0	101

MORNING	EVENING	N/S	EX
MID-DAY	MIDNIGHT	E/W	EX
CLEARANCE	BASIC TIME	SEQUENCE	HISTORY

MM-3-3 EVENING SPLIT PATTERNS

TIMING PLAN 1				SEQUENCE			
SEQUENCE 3				R1	1 1	2 4	3 4
ACTION PLAN				R2	5 4	6 4	7 4
MOVEMENTS	NBT	SBL	WBT	SBT	NBL	EBT	

I/W	WALK & GREEN	N/S
FDW & GREEN		
GREEN		
w/o WALK		
LEFT		

MM-3-2 AVAILABLE COORDINATOR PATTERN #s



HYPERLINKS TO EVENING TIME-SPACE DIAGRAMS

PLAN # 7 DATE EFFECTIVE 11/15/2002 OPERATIVE TIMES 1530-1830

PHASE	1	RING 1	2	3	4	5	RING 2	6	7	8	TARGET
SPLIT	46	14	39	15	38	22	15	39	114		
COORD	X				X						
RECALLS (V, P, Mx)	V				V						
GREEN	39	9	31	15	31	17	7	39			



7 1	7 2	7 3	7 4	7 5	7 6
-----	-----	-----	-----	-----	-----

DIR	COORD	B.O.G.
1	NB	85



PLAN # 8 DATE EFFECTIVE OPERATIVE TIMES

PHASE	1	RING 1	2	3	4	5	RING 2	6	7	8	TARGET
SPLIT	50	14	37	13	42	22	13	37	114		
COORD	X				X						
RECALLS (V, P, Mx)	V				V						
GREEN	43	9	29	13	35	17	5	37			



8 1	8 2	8 3	8 4	8 5	8 6
-----	-----	-----	-----	-----	-----

DIR	COORD	B.O.G.
2	SB	85



PLAN # 9 DATE EFFECTIVE OPERATIVE TIMES

PHASE	1	RING 1	2	3	4	5	RING 2	6	7	8	TARGET
SPLIT	40	14	42	18	32	22	18	42	114		
COORD	X				X						
RECALLS (V, P, Mx)	V				V						
GREEN	33	9	34	18	25	17	10	42			



9 1	9 2	9 3	9 4	9 5	9 6
-----	-----	-----	-----	-----	-----

DIR	COORD	B.O.G.
3	NS	85



DIR	COORD	B.O.G.
4	EB	0



DIR	COORD	B.O.G.
5	WB	0



DIR	COORD	B.O.G.
6	EW	0





THOMPSON PK & McDOWELL MT. RANCH

BASIC TIMING PLANS

RECOMMENDED
CLEARANCES

	N/S	E/W	LEFT TURN	DATE DESIGNED	SYSTEM #	SECTION #
F.D.W.	26	34	STANDARD	2/9/2010	234	101
YELLOW	4.7	4	3.0			
ALL-RED	2.3	4	1.0			

COMMUNICATIONS I.P. ADDRESS
MM-1-5-1 172.17. 12.34

TIMING #1	TIMING #2	TIMING #3	TIMING #4
CLEARANCE	SEQUENCE	PATTERNS	HISTORY

MM-2-1
TIMING PLAN #1

GREENS

PEDESTRIAN

MAXIMUMS

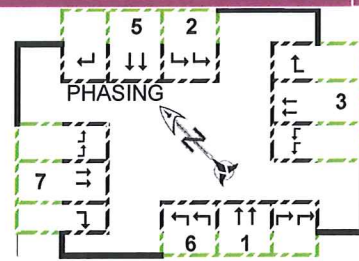
REDS

VOL DENSITY

MM-2-8

RECALLS

PHASE	1	2	3	5	6	7	9	10	11	12	13	14	15	16
MOVEMENT	NBT	SBL	WBT	SBT	NBL	EBT								
NOTES			T&L			T&L								
MIN GRN	10	5	12	10	5	5								
BK MGRN														
CS MGRN														
DLY GRN														
WALK	9		11	9		11								
WALK2														
WLK MAX														
PED CLR/FDW	26		34	26		34								
PD CLR2														
PC MAX														
PED CO														
VEH EXT		1.5	2		1.5	0.8								
VH EXT2														
MAX 1	50	25	35	50	25	30								
MAX 2	70	35	50	70	35	50								
MAX 3														
DYM MAX														
DYM STP														
YELLOW	4.7	3	4	4.7	3	4								
RED CLR	2.3	2	4	2.3	2	4								
RED MAX														
RED RVT	2		2	2		2								
ACT B4														
SEC/ACT														
MAX INT														
TIME B4														
CARS WT														
STPTDUC														
TTREDUC														
MIN GAP														
LOCK DET														
VEH RECALL	X			X										
PED RECALL														
MAX RECALL														
SOFT RECALL														
NO REST														
ADD INIT CAL														



1	2	3	4	5	6	7	8
43	9	36	19	35	19	11	44
59	55	52	60	59	55	52	60

SPLIT PLAN MAXIMUMS

NOTES

Split phases 3 & 7. Ph7 leads with Sequence #3. Ensure barriers are set accordingly @ MM1-1-1



Trip Generation Calculations

Kimley»Horn

Notes:
(1) AM and/or PM rates correspond to peak hour of generator
(2) Land use was removed in *Trip Generation, 10 Edition*; trip generation data from the *ITE Trip Generation, 9th Edition*

Kimley»Horn

[illegible]

5/13/2019
7:42 AM
Planner Sheet

Kimley»Horn

Project Name SWC 99th St and McDowell Mountain Ranch Road
Project Number 291350000

























Notes:
(1) AM and/or PM rates correspond to peak hour of generator
(2) Land use was removed in *Trip Generation, 10 Edition*; trip generation data from the *ITE Trip Generation, 9th Edition*

AM Existing Traffic Capacity Analysis

Lanes, Volumes, Timings

SWC 99th Place and McDowell Mountain Ranch Road













1: Thompson Peak Parkway & McDowell Mountain Ranch Road

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	47	49	185	767	82	143	173	443	349	116	718	23
Future Volume (vph)	47	49	185	767	82	143	173	443	349	116	718	23
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	300		175	250		170	225		225	260		160
Storage Lanes	2		1	2		1	2		2	2		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	0.88	0.97	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	3433	3539	2787	3433	3539	1583
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	3433	3539	2787	3433	3539	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			138			152			360			115
Link Speed (mph)		40			40			45			45	
Link Distance (ft)		1602			747			715			953	
Travel Time (s)		27.3			12.7			10.8			14.4	
Peak Hour Factor	0.82	0.82	0.82	0.94	0.94	0.94	0.97	0.97	0.97	0.94	0.94	0.94
Adj. Flow (vph)	57	60	226	816	87	152	178	457	360	123	764	24
Shared Lane Traffic (%)												
Lane Group Flow (vph)	57	60	226	816	87	152	178	457	360	123	764	24
Turn Type	Split	NA	pm+ov	Split	NA	pm+ov	Prot	NA	pm+ov	Prot	NA	pm+ov
Protected Phases	7	7	6	3	3	2	6	1	3	2	5	7
Permitted Phases			7			3			1			5
Detector Phase	7	7	6	3	3	2	6	1	3	2	5	7
Switch Phase												
Minimum Initial (s)	5.0	5.0	5.0	12.0	12.0	5.0	5.0	10.0	12.0	5.0	10.0	5.0
Minimum Split (s)	13.0	13.0	10.0	36.0	36.0	10.0	10.0	28.0	36.0	10.0	25.0	13.0
Total Split (s)	19.0	19.0	15.0	36.0	36.0	12.0	15.0	28.0	36.0	12.0	25.0	19.0
Total Split (%)	20.0%	20.0%	15.8%	37.9%	37.9%	12.6%	15.8%	29.5%	37.9%	12.6%	26.3%	20.0%
Maximum Green (s)	11.0	11.0	10.0	28.0	28.0	7.0	10.0	21.0	28.0	7.0	18.0	11.0
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	3.0	3.0	4.7	4.0	3.0	4.7	4.0
All-Red Time (s)	4.0	4.0	2.0	4.0	4.0	2.0	2.0	2.3	4.0	2.0	2.3	4.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	8.0	8.0	5.0	8.0	8.0	5.0	5.0	7.0	8.0	5.0	7.0	8.0
Lead/Lag			Lag			Lag	Lag	Lead		Lag	Lead	
Lead-Lag Optimize?												
Vehicle Extension (s)	0.8	0.8	1.5	2.0	2.0	1.5	1.5	0.2	2.0	1.5	0.2	0.8
Recall Mode	None	None	None	None	None	None	None	C-Max	None	None	C-Max	None
Walk Time (s)				11.0	11.0			9.0	11.0		9.0	
Flash Dont Walk (s)				17.0	17.0			12.0	17.0		9.0	
Pedestrian Calls (#/hr)				0	0			0	0		0	
Act Effct Green (s)	5.4	5.4	16.3	26.4	26.4	40.8	9.5	31.4	58.3	6.5	28.4	38.2
Actuated g/C Ratio	0.06	0.06	0.17	0.28	0.28	0.43	0.10	0.33	0.61	0.07	0.30	0.40
v/c Ratio	0.29	0.30	0.59	0.86	0.09	0.20	0.52	0.39	0.19	0.53	0.72	0.03
Control Delay	46.8	46.8	13.6	42.5	24.9	3.3	46.3	27.6	0.8	51.2	36.7	0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	46.8	46.8	13.6	42.5	24.9	3.3	46.3	27.6	0.8	51.2	36.7	0.1

Lanes, Volumes, Timings

SWC 99th Place and McDowell Mountain Ranch Road

1: Thompson Peak Parkway & McDowell Mountain Ranch Road

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
LOS	D	D	B	D	C	A	D	C	A	D	D	A
Approach Delay		24.9			35.4			21.2			37.7	
Approach LOS		C			D			C			D	
Queue Length 50th (ft)	17	18	23	233	20	0	53	118	0	37	231	0
Queue Length 95th (ft)	33	35	47	306	37	33	87	170	9	66	#346	0
Internal Link Dist (ft)		1522			667			635			873	
Turn Bay Length (ft)	300		175	250		170	225		225	260		160
Base Capacity (vph)	397	409	393	1011	1043	744	361	1168	1851	252	1057	674
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.15	0.58	0.81	0.08	0.20	0.49	0.39	0.19	0.49	0.72	0.04

Intersection Summary

Area Type: Other

Cycle Length: 95

Actuated Cycle Length: 95

Offset: 85 (89%), Referenced to phase 1:NBT and 5:SBT, Start of Green

Natural Cycle: 90

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.86

Intersection Signal Delay: 30.7

Intersection LOS: C

Intersection Capacity Utilization 70.0%







ICU Level of Service C

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Thompson Peak Parkway & McDowell Mountain Ranch Road

			
Ø1 (R)	Ø2	Ø3	Ø7
28 s	12 s	36 s	19 s
			
Ø5 (R)	Ø6		
25 s	15 s		

2: McDowell Mountain Ranch Road & 98th Street

Intersection

Int Delay, s/veh 4.4

Movement EBL EBT WBT WBR SBL SBR

Lane Configurations

Traffic Vol, veh/h 2 20 39 239 162 6

Future Vol, veh/h 2 20 39 239 162 6

Conflicting Peds, #/hr 0 0 0 0 0 0

Sign Control Free Free Free Free Stop Stop

RT Channelized - None - None - None

Storage Length - - - 0 0 -

Veh in Median Storage, # - 0 0 - 0 -

Grade, % - 0 0 - 0 -

Peak Hour Factor 55 55 63 63 57 57

Heavy Vehicles, % 2 2 2 2 2 2

Mvmt Flow 4 36 62 379 284 11

Major/Minor Major1 Major2 Minor2

Conflicting Flow All 441 0 - 0 106 62

Stage 1 - - - - 62 -

Stage 2 - - - - 44 -

Critical Hdwy 4.12 - - - 6.42 6.22

Critical Hdwy Stg 1 - - - - 5.42 -

Critical Hdwy Stg 2 - - - - 5.42 -

Follow-up Hdwy 2.218 - - - 3.518 3.318

Pot Cap-1 Maneuver 1119 - - - 892 1003

Stage 1 - - - - 961 -

Stage 2 - - - - 978 -

Platoon blocked, % - - - -

Mov Cap-1 Maneuver 1119 - - - 888 1003

Mov Cap-2 Maneuver - - - - 846 -

Stage 1 - - - - 957 -

Stage 2 - - - - 978 -

Approach EB WB SB

HCM Control Delay, s 0.7 0 11.5

HCM LOS B

Minor Lane/Major Mvmt EBL EBT WBT WBR SBLn1

Capacity (veh/h) 1119 - - - 851

HCM Lane V/C Ratio 0.003 - - - 0.346

HCM Control Delay (s) 8.2 0 - - 11.5

HCM Lane LOS A A - - B

























HCM 95th %tile Q(veh) 0 - - - 1.6

PM Existing Traffic Capacity Analysis

Lanes, Volumes, Timings

SWC 99th Place and McDowell Mountain Ranch Road













1: Thompson Peak Parkway & McDowell Mountain Ranch Road

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	30	68	178	622	50	115	135	655	578	189	706	12
Future Volume (vph)	30	68	178	622	50	115	135	655	578	189	706	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	300		175	250		170	225		225	260		160
Storage Lanes	2		1	2		1	2		2	2		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	0.88	0.97	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	3433	3539	2787	3433	3539	1583
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	3433	3539	2787	3433	3539	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			115			182			318			163
Link Speed (mph)		40			40			45			45	
Link Distance (ft)		1602			747			715			953	
Travel Time (s)		27.3			12.7			10.8			14.4	
Peak Hour Factor	0.94	0.94	0.94	0.96	0.96	0.96	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	32	72	189	648	52	120	142	689	608	199	743	13
Shared Lane Traffic (%)												
Lane Group Flow (vph)	32	72	189	648	52	120	142	689	608	199	743	13
Turn Type	Split	NA	pm+ov	Split	NA	pm+ov	Prot	NA	pm+ov	Prot	NA	pm+ov
Protected Phases	7	7	6	3	3	2	6	1	3	2	5	7
Permitted Phases			7			3			1			5
Detector Phase	7	7	6	3	3	2	6	1	3	2	5	7
Switch Phase												
Minimum Initial (s)	5.0	5.0	5.0	12.0	12.0	5.0	5.0	10.0	12.0	5.0	10.0	5.0
Minimum Split (s)	13.0	13.0	10.0	39.0	39.0	10.0	10.0	37.0	39.0	10.0	37.0	13.0
Total Split (s)	15.0	15.0	22.0	39.0	39.0	14.0	22.0	46.0	39.0	14.0	38.0	15.0
Total Split (%)	13.2%	13.2%	19.3%	34.2%	34.2%	12.3%	19.3%	40.4%	34.2%	12.3%	33.3%	13.2%
Maximum Green (s)	7.0	7.0	17.0	31.0	31.0	9.0	17.0	39.0	31.0	9.0	31.0	7.0
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	3.0	3.0	4.7	4.0	3.0	4.7	4.0
All-Red Time (s)	4.0	4.0	2.0	4.0	4.0	2.0	2.0	2.3	4.0	2.0	2.3	4.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	8.0	8.0	5.0	8.0	8.0	5.0	5.0	7.0	8.0	5.0	7.0	8.0
Lead/Lag			Lag			Lag	Lag	Lead		Lag	Lead	
Lead-Lag Optimize?												
Vehicle Extension (s)	0.8	0.8	1.5	2.0	2.0	1.5	1.5	0.2	2.0	1.5	0.2	0.8
Recall Mode	None	None	None	None	None	None	None	C-Max	None	None	C-Max	None
Walk Time (s)				11.0	11.0			9.0	11.0		9.0	
Flash Dont Walk (s)				20.0	20.0			21.0	20.0		21.0	
Pedestrian Calls (#/hr)				0	0			0	0		0	
Act Effct Green (s)	5.8	5.8	23.9	27.2	27.2	43.9	16.7	46.9	74.7	8.7	38.9	49.1
Actuated g/C Ratio	0.05	0.05	0.21	0.24	0.24	0.39	0.15	0.41	0.66	0.08	0.34	0.43
v/c Ratio	0.18	0.40	0.45	0.79	0.06	0.17	0.28	0.47	0.31	0.76	0.62	0.02
Control Delay	53.9	58.9	11.1	48.1	32.0	1.0	44.9	27.8	2.7	70.7	36.1	0.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	53.9	58.9	11.1	48.1	32.0	1.0	44.9	27.8	2.7	70.7	36.1	0.0

Lanes, Volumes, Timings

SWC 99th Place and McDowell Mountain Ranch Road

1: Thompson Peak Parkway & McDowell Mountain Ranch Road

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
LOS	D	E	B	D	C	A	D	C	A	E	D	A
Approach Delay		27.5			40.2			18.9			42.8	
Approach LOS		C			D			B			D	
Queue Length 50th (ft)	11	27	22	228	15	0	48	202	20	74	250	0
Queue Length 95th (ft)	28	51	50	285	31	7	79	277	34	#126	337	0
Internal Link Dist (ft)		1522			667			635			873	
Turn Bay Length (ft)	300		175	250		170	225		225	260		160
Base Capacity (vph)	210	217	426	933	962	713	511	1455	1974	271	1207	724
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.15	0.33	0.44	0.69	0.05	0.17	0.28	0.47	0.31	0.73	0.62	0.02

Intersection Summary

Area Type: Other

Cycle Length: 114

Actuated Cycle Length: 114

Offset: 85 (75%), Referenced to phase 1:NBT and 5:SBT, Start of Green

Natural Cycle: 100

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.79

Intersection Signal Delay: 31.1

Intersection LOS: C

Intersection Capacity Utilization 64.9%







ICU Level of Service C

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Thompson Peak Parkway & McDowell Mountain Ranch Road

			
Ø1 (R)	Ø2	Ø3	Ø7
46 s	14 s	39 s	15 s
			
Ø5 (R)	Ø6		
38 s	22 s		

Intersection

Int Delay, s/veh 5.7

Movement EBL EBT WBT WBR SBL SBR

Lane Configurations		↕	↑	↗	↘	
Traffic Vol, veh/h	2	16	22	87	148	1
Future Vol, veh/h	2	16	22	87	148	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	0	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	75	75	91	91	81	81
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	3	21	24	96	183	1

Major/Minor Major1 Major2 Minor2

Conflicting Flow All	120	0	-	0	51	24
Stage 1	-	-	-	-	24	-
Stage 2	-	-	-	-	27	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1468	-	-	-	958	1052
Stage 1	-	-	-	-	999	-
Stage 2	-	-	-	-	996	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	1468	-	-	-	956	1052
Mov Cap-2 Maneuver	-	-	-	-	891	-
Stage 1	-	-	-	-	997	-
Stage 2	-	-	-	-	996	-

Approach EB WB SB

HCM Control Delay, s	0.8	0	10.1
HCM LOS			B

Minor Lane/Major Mvmt EBL EBT WBT WBR SBLn1

























Capacity (veh/h)	1468	-	-	-	892
HCM Lane V/C Ratio	0.002	-	-	-	0.206
HCM Control Delay (s)	7.5	0	-	-	10.1
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	0.8

2021 Total AM Peak Hour Traffic Capacity Analysis

Lanes, Volumes, Timings

SWC 99th Place and McDowell Mountain Ranch Road













1: Thompson Peak Parkway & McDowell Mountain Ranch Road

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	48	49	187	767	82	143	177	443	349	116	718	24
Future Volume (vph)	48	49	187	767	82	143	177	443	349	116	718	24
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	300		175	250		170	225		225	260		160
Storage Lanes	2		1	2		1	2		2	2		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	0.88	0.97	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	3433	3539	2787	3433	3539	1583
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	3433	3539	2787	3433	3539	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			138			152			360			115
Link Speed (mph)		40			40			45			45	
Link Distance (ft)		1602			747			715			953	
Travel Time (s)		27.3			12.7			10.8			14.4	
Peak Hour Factor	0.82	0.82	0.82	0.94	0.94	0.94	0.97	0.97	0.97	0.94	0.94	0.94
Adj. Flow (vph)	59	60	228	816	87	152	182	457	360	123	764	26
Shared Lane Traffic (%)												
Lane Group Flow (vph)	59	60	228	816	87	152	182	457	360	123	764	26
Turn Type	Split	NA	pm+ov	Split	NA	pm+ov	Prot	NA	pm+ov	Prot	NA	pm+ov
Protected Phases	7	7	6	3	3	2	6	1	3	2	5	7
Permitted Phases			7			3			1			5
Detector Phase	7	7	6	3	3	2	6	1	3	2	5	7
Switch Phase												
Minimum Initial (s)	5.0	5.0	5.0	12.0	12.0	5.0	5.0	10.0	12.0	5.0	10.0	5.0
Minimum Split (s)	13.0	13.0	10.0	36.0	36.0	10.0	10.0	28.0	36.0	10.0	25.0	13.0
Total Split (s)	19.0	19.0	15.0	36.0	36.0	12.0	15.0	28.0	36.0	12.0	25.0	19.0
Total Split (%)	20.0%	20.0%	15.8%	37.9%	37.9%	12.6%	15.8%	29.5%	37.9%	12.6%	26.3%	20.0%
Maximum Green (s)	11.0	11.0	10.0	28.0	28.0	7.0	10.0	21.0	28.0	7.0	18.0	11.0
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	3.0	3.0	4.7	4.0	3.0	4.7	4.0
All-Red Time (s)	4.0	4.0	2.0	4.0	4.0	2.0	2.0	2.3	4.0	2.0	2.3	4.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	8.0	8.0	5.0	8.0	8.0	5.0	5.0	7.0	8.0	5.0	7.0	8.0
Lead/Lag			Lag			Lag	Lag	Lead		Lag	Lead	
Lead-Lag Optimize?												
Vehicle Extension (s)	0.8	0.8	1.5	2.0	2.0	1.5	1.5	0.2	2.0	1.5	0.2	0.8
Recall Mode	None	None	None	None	None	None	None	C-Max	None	None	C-Max	None
Walk Time (s)				11.0	11.0			9.0	11.0		9.0	
Flash Dont Walk (s)				17.0	17.0			12.0	17.0		9.0	
Pedestrian Calls (#/hr)				0	0			0	0		0	
Act Effct Green (s)	5.4	5.4	16.3	26.4	26.4	40.8	9.5	31.4	58.3	6.5	28.4	38.2
Actuated g/C Ratio	0.06	0.06	0.17	0.28	0.28	0.43	0.10	0.33	0.61	0.07	0.30	0.40
v/c Ratio	0.30	0.30	0.59	0.86	0.09	0.20	0.53	0.39	0.19	0.53	0.72	0.04
Control Delay	46.9	46.7	13.8	42.5	24.9	3.3	46.6	27.6	0.8	51.2	36.8	0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	46.9	46.7	13.8	42.5	24.9	3.3	46.6	27.6	0.8	51.2	36.8	0.1

Lanes, Volumes, Timings

SWC 99th Place and McDowell Mountain Ranch Road

1: Thompson Peak Parkway & McDowell Mountain Ranch Road

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
LOS	D	D	B	D	C	A	D	C	A	D	D	A
Approach Delay	25.1			35.4			21.4			37.7		
Approach LOS	C			D			C			D		
Queue Length 50th (ft)	18	18	23	233	20	0	54	118	0	37	231	0
Queue Length 95th (ft)	34	35	48	306	37	33	88	170	9	66	#346	0
Internal Link Dist (ft)	1522			667			635			873		
Turn Bay Length (ft)	300	175		250	170		225	225		260	160	
Base Capacity (vph)	397	409	393	1011	1043	744	361	1168	1851	252	1056	674
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.15	0.15	0.58	0.81	0.08	0.20	0.50	0.39	0.19	0.49	0.72	0.04

Intersection Summary

Area Type: Other

Cycle Length: 95

Actuated Cycle Length: 95

Offset: 85 (89%), Referenced to phase 1:NBT and 5:SBT, Start of Green

Natural Cycle: 90

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.86

Intersection Signal Delay: 30.7

Intersection LOS: C

Intersection Capacity Utilization 70.1%







ICU Level of Service C

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Thompson Peak Parkway & McDowell Mountain Ranch Road

 Ø1 (R)	 Ø2	 Ø3	 Ø7
28 s	12 s	36 s	19 s
 Ø5 (R)	 Ø6		
25 s	15 s		

Intersection						
Int Delay, s/veh	4.4					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕	↕	↕	↕
Traffic Vol, veh/h	2	20	39	241	166	6
Future Vol, veh/h	2	20	39	241	166	6
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	0	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	55	55	63	63	57	57
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	4	36	62	383	291	11

Major/Minor	Major1	Major2	Minor2
Conflicting Flow All	445	0	106
Stage 1	-	-	62
Stage 2	-	-	44
Critical Hdwy	4.12	-	6.42
Critical Hdwy Stg 1	-	-	5.42
Critical Hdwy Stg 2	-	-	5.42
Follow-up Hdwy	2.218	-	3.518
Pot Cap-1 Maneuver	1115	-	892
Stage 1	-	-	961
Stage 2	-	-	978
Platoon blocked, %	-	-	-
Mov Cap-1 Maneuver	1115	-	888
Mov Cap-2 Maneuver	-	-	846
Stage 1	-	-	957
Stage 2	-	-	978

Approach	EB	WB	SB
HCM Control Delay, s	0.7	0	11.5
HCM LOS	B		

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1115	-	-	-	851
HCM Lane V/C Ratio	0.003	-	-	-	0.355
HCM Control Delay (s)	8.2	0	-	-	11.5
HCM Lane LOS	A	A	-	-	B
HCM 95th %tile Q(veh)	0	-	-	-	1.6

Intersection

Int Delay, s/veh 0

Movement	EBT	EBR	WBL	WBT	NBL	NBR
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Lane Configurations	↑↑		↑	↑↑	↑	
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Traffic Vol, veh/h	185	1	0	280	0	0
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Future Vol, veh/h	185	1	0	280	0	0
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Conflicting Peds, #/hr	0	0	0	0	0	0
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Sign Control	Free	Free	Free	Free	Stop	Stop
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RT Channelized	-	None	-	None	-	None
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Storage Length	-	-	75	-	0	-
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Veh in Median Storage, #	0	-	-	0	0	-
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Grade, %	0	-	-	0	0	-
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Peak Hour Factor	92	92	92	92	92	92
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Heavy Vehicles, %	2	2	2	2	2	2
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Mvmt Flow	201	1	0	304	0	0
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Major/Minor	Major1	Major2	Minor1
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Conflicting Flow All	0	0	202	0	354	101
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Stage 1	-	-	-	-	202	-
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Stage 2	-	-	-	-	152	-
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Critical Hdwy	-	-	4.14	-	6.84	6.94
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Critical Hdwy Stg 1	-	-	-	-	5.84	-
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Critical Hdwy Stg 2	-	-	-	-	5.84	-
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Follow-up Hdwy	-	-	2.22	-	3.52	3.32
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Pot Cap-1 Maneuver	-	-	1367	-	618	935
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Stage 1	-	-	-	-	812	-
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Stage 2	-	-	-	-	860	-
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Platoon blocked, %	-	-	-	-	-	-
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Mov Cap-1 Maneuver	-	-	1367	-	618	935
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Mov Cap-2 Maneuver	-	-	-	-	663	-
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Stage 1	-	-	-	-	812	-
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Stage 2	-	-	-	-	860	-
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Approach	EB	WB	NB
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HCM Control Delay, s	0	0	0
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HCM LOS			A
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Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
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Capacity (veh/h)	-	-	-	1367	-
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HCM Lane V/C Ratio	-	-	-	-	-
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HCM Control Delay (s)	0	-	-	0	-
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HCM Lane LOS	A	-	-	A	-
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HCM 95th %tile Q(veh)	-	-	-	0	-
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Intersection						
Int Delay, s/veh	0.2					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑		↑	↑↑	↑	
Traffic Vol, veh/h	182	3	5	278	2	3
Future Vol, veh/h	182	3	5	278	2	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	75	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	198	3	5	302	2	3
Major/Minor	Major1	Major2		Minor1		
Conflicting Flow All	0	0	201	0	361	101
Stage 1	-	-	-	-	200	-
Stage 2	-	-	-	-	161	-
Critical Hdwy	-	-	4.14	-	6.84	6.94
Critical Hdwy Stg 1	-	-	-	-	5.84	-
Critical Hdwy Stg 2	-	-	-	-	5.84	-
Follow-up Hdwy	-	-	2.22	-	3.52	3.32
Pot Cap-1 Maneuver	-	-	1368	-	611	935
Stage 1	-	-	-	-	814	-
Stage 2	-	-	-	-	851	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1368	-	609	935
Mov Cap-2 Maneuver	-	-	-	-	656	-
Stage 1	-	-	-	-	811	-
Stage 2	-	-	-	-	851	-
Approach	EB	WB		NB		
HCM Control Delay, s	0	0.1		9.5		
HCM LOS	A					
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	799	-	-	1368	-	
HCM Lane V/C Ratio	0.007	-	-	0.004	-	
HCM Control Delay (s)	9.5	-	-	7.6	-	
HCM Lane LOS	A	-	-	A	-	
HCM 95th %tile Q(veh)	0	-	-	0	-	

2021 Total PM Peak Hour Traffic Capacity Analysis

Lanes, Volumes, Timings

SWC 99th Place and McDowell Mountain Ranch Road













1: Thompson Peak Parkway & McDowell Mountain Ranch Road

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	32	68	185	622	50	115	142	655	578	189	706	14
Future Volume (vph)	32	68	185	622	50	115	142	655	578	189	706	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	300		175	250		170	225		225	260		160
Storage Lanes	2		1	2		1	2		2	2		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	0.97	0.95	0.88	0.97	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	3433	3539	2787	3433	3539	1583
Flt Permitted	0.950			0.950			0.950			0.950		
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	3433	3539	2787	3433	3539	1583
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			115			182			318			163
Link Speed (mph)		40			40			45			45	
Link Distance (ft)		1602			747			715			953	
Travel Time (s)		27.3			12.7			10.8			14.4	
Peak Hour Factor	0.94	0.94	0.94	0.96	0.96	0.96	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	34	72	197	648	52	120	149	689	608	199	743	15
Shared Lane Traffic (%)												
Lane Group Flow (vph)	34	72	197	648	52	120	149	689	608	199	743	15
Turn Type	Split	NA	pm+ov	Split	NA	pm+ov	Prot	NA	pm+ov	Prot	NA	pm+ov
Protected Phases	7	7	6	3	3	2	6	1	3	2	5	7
Permitted Phases			7			3			1			5
Detector Phase	7	7	6	3	3	2	6	1	3	2	5	7
Switch Phase												
Minimum Initial (s)	5.0	5.0	5.0	12.0	12.0	5.0	5.0	10.0	12.0	5.0	10.0	5.0
Minimum Split (s)	13.0	13.0	10.0	39.0	39.0	10.0	10.0	37.0	39.0	10.0	37.0	13.0
Total Split (s)	15.0	15.0	22.0	39.0	39.0	14.0	22.0	46.0	39.0	14.0	38.0	15.0
Total Split (%)	13.2%	13.2%	19.3%	34.2%	34.2%	12.3%	19.3%	40.4%	34.2%	12.3%	33.3%	13.2%
Maximum Green (s)	7.0	7.0	17.0	31.0	31.0	9.0	17.0	39.0	31.0	9.0	31.0	7.0
Yellow Time (s)	4.0	4.0	3.0	4.0	4.0	3.0	3.0	4.7	4.0	3.0	4.7	4.0
All-Red Time (s)	4.0	4.0	2.0	4.0	4.0	2.0	2.0	2.3	4.0	2.0	2.3	4.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	8.0	8.0	5.0	8.0	8.0	5.0	5.0	7.0	8.0	5.0	7.0	8.0
Lead/Lag			Lag			Lag	Lag	Lead		Lag	Lead	
Lead-Lag Optimize?												
Vehicle Extension (s)	0.8	0.8	1.5	2.0	2.0	1.5	1.5	0.2	2.0	1.5	0.2	0.8
Recall Mode	None	None	None	None	None	None	None	C-Max	None	None	C-Max	None
Walk Time (s)				11.0	11.0			9.0	11.0		9.0	
Flash Dont Walk (s)				20.0	20.0			21.0	20.0		21.0	
Pedestrian Calls (#/hr)				0	0			0	0		0	
Act Effct Green (s)	5.8	5.8	23.9	27.2	27.2	43.9	16.7	46.9	74.7	8.7	38.9	49.1
Actuated g/C Ratio	0.05	0.05	0.21	0.24	0.24	0.39	0.15	0.41	0.66	0.08	0.34	0.43
v/c Ratio	0.20	0.40	0.47	0.79	0.06	0.17	0.30	0.47	0.31	0.76	0.62	0.02
Control Delay	54.1	58.9	11.8	48.1	32.0	1.0	45.1	27.8	2.7	70.7	36.1	0.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	54.1	58.9	11.8	48.1	32.0	1.0	45.1	27.8	2.7	70.7	36.1	0.1

Lanes, Volumes, Timings

SWC 99th Place and McDowell Mountain Ranch Road

1: Thompson Peak Parkway & McDowell Mountain Ranch Road

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
LOS	D	E	B	D	C	A	D	C	A	E	D	A
Approach Delay		27.7			40.2			19.0			42.7	
Approach LOS		C			D			B			D	
Queue Length 50th (ft)	12	27	25	228	15	0	50	202	20	74	250	0
Queue Length 95th (ft)	29	51	53	285	31	7	82	277	34	#126	337	0
Internal Link Dist (ft)		1522			667			635			873	
Turn Bay Length (ft)	300		175	250		170	225		225	260		160
Base Capacity (vph)	210	217	426	933	962	713	511	1455	1974	271	1207	724
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.16	0.33	0.46	0.69	0.05	0.17	0.29	0.47	0.31	0.73	0.62	0.02

Intersection Summary

Area Type: Other

Cycle Length: 114

Actuated Cycle Length: 114

Offset: 85 (75%), Referenced to phase 1:NBT and 5:SBT, Start of Green

Natural Cycle: 100

Control Type: Actuated-Coordinated

Maximum v/c Ratio: 0.79

Intersection Signal Delay: 31.1

Intersection LOS: C

Intersection Capacity Utilization 65.4%







ICU Level of Service C

Analysis Period (min) 15

95th percentile volume exceeds capacity, queue may be longer.

Queue shown is maximum after two cycles.

Splits and Phases: 1: Thompson Peak Parkway & McDowell Mountain Ranch Road

			
Ø1 (R)	Ø2	Ø3	Ø7
46 s	14 s	39 s	15 s
			
Ø5 (R)	Ø6		
38 s	22 s		

Intersection

Int Delay, s/veh 5.7

Movement	EBL	EBT	WBT	WBR	SBL	SBR
----------	-----	-----	-----	-----	-----	-----

Lane Configurations		↕	↕	↕	↕	↕
---------------------	--	---	---	---	---	---

Traffic Vol, veh/h	2	16	22	93	154	1
--------------------	---	----	----	----	-----	---

Future Vol, veh/h	2	16	22	93	154	1
-------------------	---	----	----	----	-----	---

Conflicting Peds, #/hr	0	0	0	0	0	0
------------------------	---	---	---	---	---	---

Sign Control	Free	Free	Free	Free	Stop	Stop
--------------	------	------	------	------	------	------

RT Channelized	-	None	-	None	-	None
----------------	---	------	---	------	---	------

Storage Length	-	-	-	0	0	-
----------------	---	---	---	---	---	---

Veh in Median Storage, #	-	0	0	-	0	-
--------------------------	---	---	---	---	---	---

Grade, %	-	0	0	-	0	-
----------	---	---	---	---	---	---

Peak Hour Factor	75	75	91	91	81	81
------------------	----	----	----	----	----	----

Heavy Vehicles, %	2	2	2	2	2	2
-------------------	---	---	---	---	---	---

Mvmt Flow	3	21	24	102	190	1
-----------	---	----	----	-----	-----	---

Major/Minor	Major1	Major2	Minor2
-------------	--------	--------	--------

Conflicting Flow All	126	0	0	51	24
----------------------	-----	---	---	----	----

Stage 1	-	-	-	24	-
---------	---	---	---	----	---

Stage 2	-	-	-	27	-
---------	---	---	---	----	---

Critical Hdwy	4.12	-	-	6.42	6.22
---------------	------	---	---	------	------

Critical Hdwy Stg 1	-	-	-	5.42	-
---------------------	---	---	---	------	---

Critical Hdwy Stg 2	-	-	-	5.42	-
---------------------	---	---	---	------	---

Follow-up Hdwy	2.218	-	-	3.518	3.318
----------------	-------	---	---	-------	-------

Pot Cap-1 Maneuver	1460	-	-	958	1052
--------------------	------	---	---	-----	------

Stage 1	-	-	-	999	-
---------	---	---	---	-----	---

Stage 2	-	-	-	996	-
---------	---	---	---	-----	---

Platoon blocked, %	-	-	-	-	-
--------------------	---	---	---	---	---

Mov Cap-1 Maneuver	1460	-	-	956	1052
--------------------	------	---	---	-----	------

Mov Cap-2 Maneuver	-	-	-	891	-
--------------------	---	---	---	-----	---

Stage 1	-	-	-	997	-
---------	---	---	---	-----	---

Stage 2	-	-	-	996	-
---------	---	---	---	-----	---

Approach	EB	WB	SB
----------	----	----	----

HCM Control Delay, s	0.8	0	10.1
----------------------	-----	---	------

HCM LOS			B
---------	--	--	---

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
-----------------------	-----	-----	-----	-----	-------

Capacity (veh/h)	1460	-	-	-	892
------------------	------	---	---	---	-----

HCM Lane V/C Ratio	0.002	-	-	-	0.215
--------------------	-------	---	---	---	-------

HCM Control Delay (s)	7.5	0	-	-	10.1
-----------------------	-----	---	---	---	------

HCM Lane LOS	A	A	-	-	B
--------------	---	---	---	---	---

HCM 95th %tile Q(veh)	0	-	-	-	0.8
-----------------------	---	---	---	---	-----

Intersection

Int Delay, s/veh 0

Movement	EBT	EBR	WBL	WBT	NBL	NBR
----------	-----	-----	-----	-----	-----	-----

Lane Configurations	↑↑		↑	↑↑	↑	
---------------------	----	--	---	----	---	--

Traffic Vol, veh/h	169	1	0	114	1	0
--------------------	-----	---	---	-----	---	---

Future Vol, veh/h	169	1	0	114	1	0
-------------------	-----	---	---	-----	---	---

Conflicting Peds, #/hr	0	0	0	0	0	0
------------------------	---	---	---	---	---	---

Sign Control	Free	Free	Free	Free	Stop	Stop
--------------	------	------	------	------	------	------

RT Channelized	-	None	-	None	-	None
----------------	---	------	---	------	---	------

Storage Length	-	-	75	-	0	-
----------------	---	---	----	---	---	---

Veh in Median Storage, #	0	-	-	0	0	-
--------------------------	---	---	---	---	---	---

Grade, %	0	-	-	0	0	-
----------	---	---	---	---	---	---

Peak Hour Factor	92	92	92	92	92	92
------------------	----	----	----	----	----	----

Heavy Vehicles, %	2	2	2	2	2	2
-------------------	---	---	---	---	---	---

Mvmt Flow	184	1	0	124	1	0
-----------	-----	---	---	-----	---	---

Major/Minor	Major1	Major2	Minor1
-------------	--------	--------	--------

Conflicting Flow All	0	0	185	0	247	93
----------------------	---	---	-----	---	-----	----

Stage 1	-	-	-	-	185	-
---------	---	---	---	---	-----	---

Stage 2	-	-	-	-	62	-
---------	---	---	---	---	----	---

Critical Hdwy	-	-	4.14	-	6.84	6.94
---------------	---	---	------	---	------	------

Critical Hdwy Stg 1	-	-	-	-	5.84	-
---------------------	---	---	---	---	------	---

Critical Hdwy Stg 2	-	-	-	-	5.84	-
---------------------	---	---	---	---	------	---

Follow-up Hdwy	-	-	2.22	-	3.52	3.32
----------------	---	---	------	---	------	------

Pot Cap-1 Maneuver	-	-	1387	-	720	946
--------------------	---	---	------	---	-----	-----

Stage 1	-	-	-	-	828	-
---------	---	---	---	---	-----	---

Stage 2	-	-	-	-	953	-
---------	---	---	---	---	-----	---

Platoon blocked, %	-	-	-	-	-	-
--------------------	---	---	---	---	---	---

Mov Cap-1 Maneuver	-	-	1387	-	720	946
--------------------	---	---	------	---	-----	-----

Mov Cap-2 Maneuver	-	-	-	-	725	-
--------------------	---	---	---	---	-----	---

Stage 1	-	-	-	-	828	-
---------	---	---	---	---	-----	---

Stage 2	-	-	-	-	953	-
---------	---	---	---	---	-----	---

Approach	EB	WB	NB
----------	----	----	----

HCM Control Delay, s	0	0	10
----------------------	---	---	----

HCM LOS			B
---------	--	--	---

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
-----------------------	-------	-----	-----	-----	-----

Capacity (veh/h)	725	-	-	1387	-
------------------	-----	---	---	------	---

HCM Lane V/C Ratio	0.001	-	-	-	-
--------------------	-------	---	---	---	---

HCM Control Delay (s)	10	-	-	0	-
-----------------------	----	---	---	---	---

HCM Lane LOS	B	-	-	A	-
--------------	---	---	---	---	---

HCM 95th %tile Q(veh)	0	-	-	0	-
-----------------------	---	---	---	---	---

4: Driveway D2 & McDowell Mountain Ranch Road

Intersection						
Int Delay, s/veh	0.7					
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑↑			↑↑	↑↑	
Traffic Vol, veh/h	164	5	9	109	5	9
Future Vol, veh/h	164	5	9	109	5	9
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	178	5	10	118	5	10
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	183	0	260	92
Stage 1	-	-	-	-	181	-
Stage 2	-	-	-	-	79	-
Critical Hdwy	-	-	4.14	-	6.84	6.94
Critical Hdwy Stg 1	-	-	-	-	5.84	-
Critical Hdwy Stg 2	-	-	-	-	5.84	-
Follow-up Hdwy	-	-	2.22	-	3.52	3.32
Pot Cap-1 Maneuver	-	-	1389	-	707	947
Stage 1	-	-	-	-	832	-
Stage 2	-	-	-	-	935	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	-	-	1389	-	701	947
Mov Cap-2 Maneuver	-	-	-	-	713	-
Stage 1	-	-	-	-	825	-
Stage 2	-	-	-	-	935	-
Approach	EB		WB		NB	
HCM Control Delay, s	0		0.6		9.3	
HCM LOS					A	
Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT	
Capacity (veh/h)	848	-	-	1389	-	
HCM Lane V/C Ratio	0.018	-	-	0.007	-	
HCM Control Delay (s)	9.3	-	-	7.6	-	
HCM Lane LOS	A	-	-	A	-	
HCM 95th %tile Q(veh)	0.1	-	-	0	-	

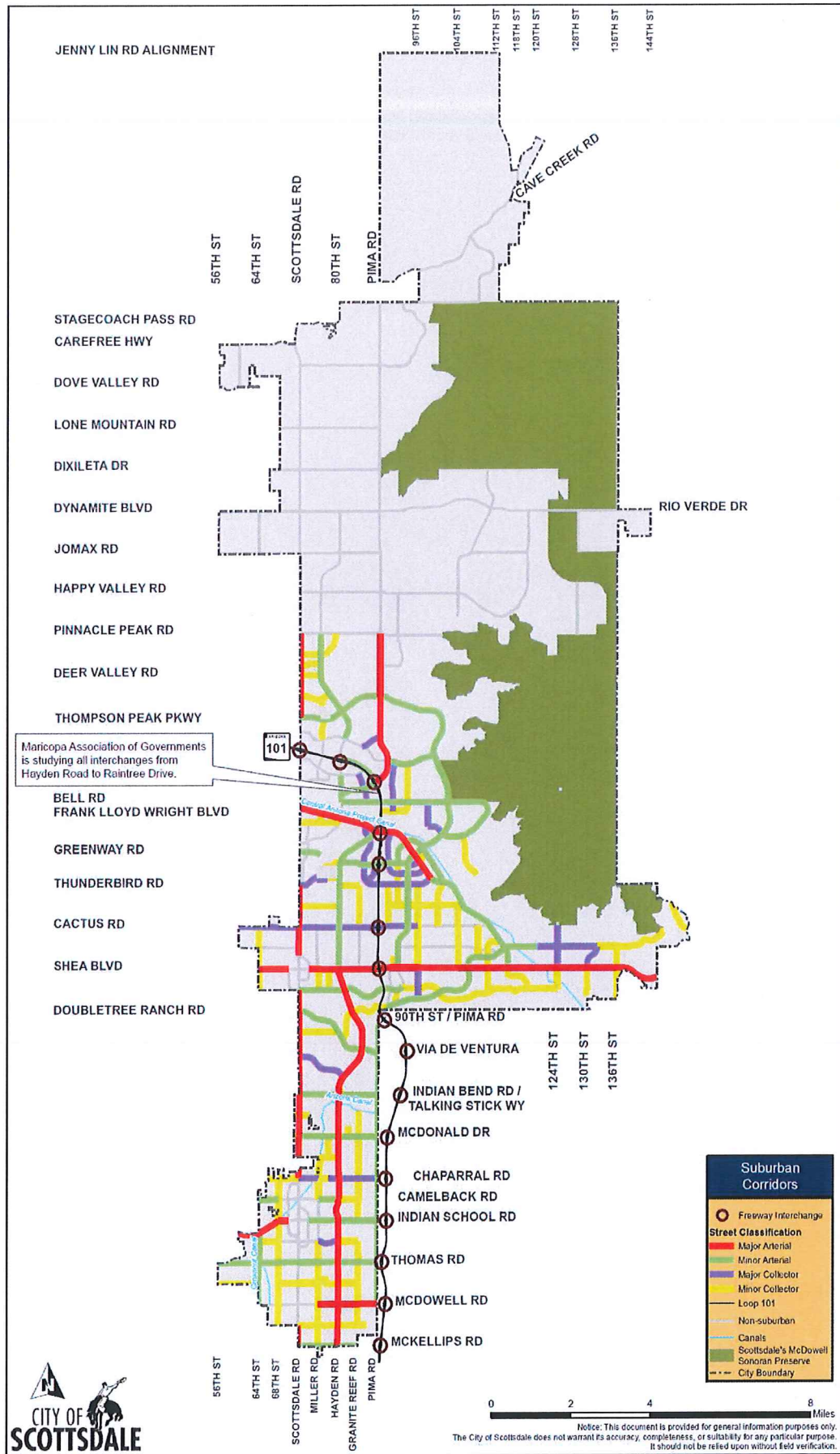
Left-Turn Storage Calculations

Left-turn Storage Analysis

[illegible]

City of Scottsdale Standards

Figure 7: Suburban Street Classifications – Entire City



CITY OF SCOTTSDALE TRANSPORTATION MASTER PLAN 2016
ADOPTED BY CITY COUNCIL, JULY 5, 2016



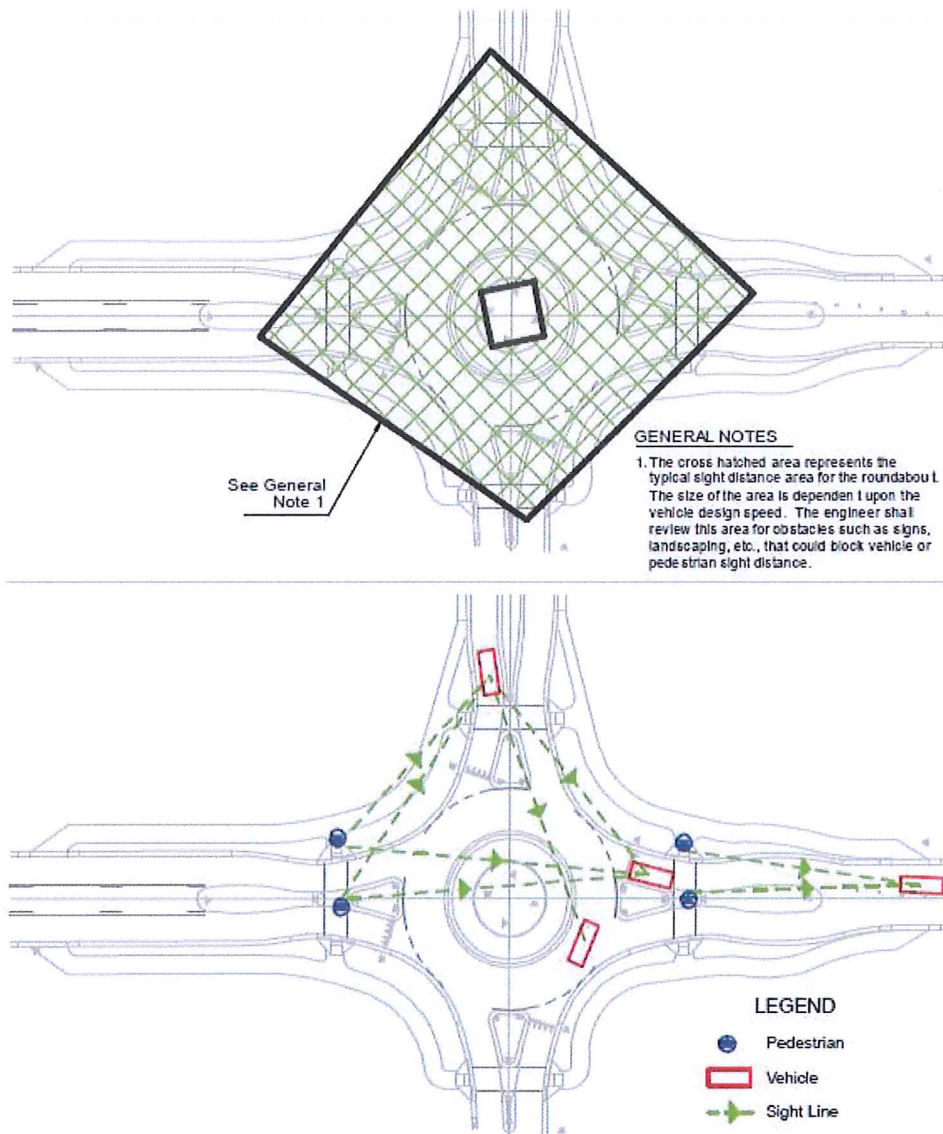


FIGURE 5-3.34 ROUNDABOUT SIGHT DISTANCE

STREET ACCESS AND DRIVEWAYS

Driveway types are determined by land use type and street classification. The standards for these driveway types are illustrated in Figure 5-3.38 through Figure 5-3.43. Refer to Figure 5-3.39 for driveway grade standards.

DRIVEWAY SPACING

Standard and minimum driveway spacing will generally conform to the following standards. This minimum spacing applies to proposed site driveway separation as well

5-3.2000

5-3.201

as separation from existing or planned driveways and streets on adjacent parcels. The spacing is measured to the driveway or street centerline.

STREET TYPE	STANDARD DRIVEWAY SPACING	MINIMUM DRIVEWAY SPACING
Local Residential / Local Collector	50 feet	50 feet
Local Industrial / Local Commercial	165 feet	125 feet
Minor Collector	165 feet	125 feet
Major Collector	250 feet	150 feet
Minor Arterial	330 feet	250 feet
Major Arterial	500 feet	300 feet

FIGURE 5-3.35 DRIVEWAY SPACING

Standard driveway spacing criteria shall apply for all new driveways where there are no conflicts with existing driveway and street intersections, site frontage is adequate, and there are no conflicts with natural features or drainage structures. The minimum driveway spacing may be allowed when approved by Transportation staff where those conflicts noted above exist or other site plan associated issues do not allow the standard driveway spacing to be implemented. In locations where the standard driveway spacing cannot be achieved, a deceleration lane may be required to mitigate the impact of the closer driveway spacing.

For sites that have frontage on two streets, primary access should be onto the minor street frontage. A maximum of two driveway openings is permitted to a site or parcel from the abutting street(s). The Transportation Department may permit additional driveway entrances when projected travel demands indicate it is in the interests of good traffic operation, and when adequate street frontage exists to maintain the above guidelines.

Where new development adjoins other similarly zoned property or compatible land uses, a cross access easement may be required to permit vehicular movement between the parcels or to reduce the number of access points required onto the adjacent public street. Combining driveways reduces the number of conflict points for pedestrians, bicyclists, and other vehicles. This may be required regardless of the development status of the adjoining property, unless the cross access is determined to be unfeasible by city staff.

New driveways on collector and arterial streets in areas that do not have raised medians shall align with existing or planned driveways and street intersections to avoid creating interlocking left turns and other conflicts. Offsets in the driveway centerlines may be allowed up to 6 feet. If the driveways cannot be aligned, the driveways should be offset a minimum distance of 125 feet along streets without a center turn lane, and a minimum 250 feet along streets with a center turn lane.

When site driveway locations are modified, any existing driveways that are not going to be utilized for access must be removed and replaced with curb, gutter, and sidewalk to match the adjacent improvements.

DRIVEWAY LOCATIONS

5-3.202

A new access driveway will not be allowed (measured to the driveway centerline):

- A. Within 30 feet of any commercial property line, except when it is a joint-use driveway serving two abutting commercial properties and access agreements have been exchanged between, and recorded by, the two abutting property owners;
- B. When the total width of all driveways serving a property exceeds 50 percent of the curb line frontage;
- C. Within 50 feet of the rights-of-way line of an intersecting non-arterial street;
- D. Within 100 feet of the rights-of-way line of an intersecting arterial street;
- E. Within 100 feet of an approved median opening location on an arterial street;
- F. Less than the minimum spacing as established under Section 5-3.201;

VEHICULAR NON-ACCESS EASEMENT

5-3.203

For proper control of driveway access, a vehicular non-access easement (V.N.E.) is to be granted to the city, except at approved access points, along all collector and arterial streets when abutting property develops.

RESIDENTIAL DRIVEWAYS

5-3.204

A. Single-family Residential Development

Driveways serving single-family residential units should be S-1 type driveways as shown in Figure 5-3.40. Only one driveway per lot street frontage is allowed except where the street frontage is of sufficient length to maintain a separation of 50 feet between driveways. The minimum driveway length is 18 feet, measured from the face of the garage opening to the back of sidewalk or the back of curb if no sidewalk is provided. Refer to Section 2-2.308 for additional discussion on driveways. Refer to Standard Detail Drawings (2200 Series) for access ramp design requirements.

B. Multi-family Residential Development

Driveways serving multi-family residential units should be CL and CH type driveways, as shown in Figure 5-3.41 through Figure 5-3.44. Type CL-1 and CL-2 are low-volume driveways to be used on local streets. Type CH-1, -2 and -3 are high volume driveways to be used on collector and arterial streets. CL type driveways may be required along urban character collector and arterial streets with higher pedestrian traffic. The minimum driveway length is 50 feet, measured from the entrance to the off-street parking area to the back of sidewalk, or to the back of curb if no sidewalk is provided. Refer to Standard Detail Drawings (2200 Series) for access ramp design requirements.

C. Limitations on Residential Access

Residential properties that have frontage on a local street, an arterial, or collector street are limited to local street access.

In some instances, residential parcels fronting only on arterial or collector streets may be given access if alternate public access is not available. When such access is allowed, the driveway must be circular, or it must have a turn-around area to ensure there is no need for backing onto the street.

the intersection for approximately 75 feet to 150 feet. Short vertical curves may be necessary in lieu of grade breaks.

D. Intersection Sight Distance

To provide the opportunity for vehicles at an intersection to safely cross or make left or right turns onto a through street, adequate sight distance must be provided at all street intersections and where driveways intersect with streets. Sight distance must also be provided for left turning traffic turning from the main street as described in AASHTO Intersection Sight Distance Case F. If opposing left turn lanes are present, the opposing left turns must be designed having a positive off-set to allow for sight distance when opposing vehicles are present. Refer to Figure 5-3.28.

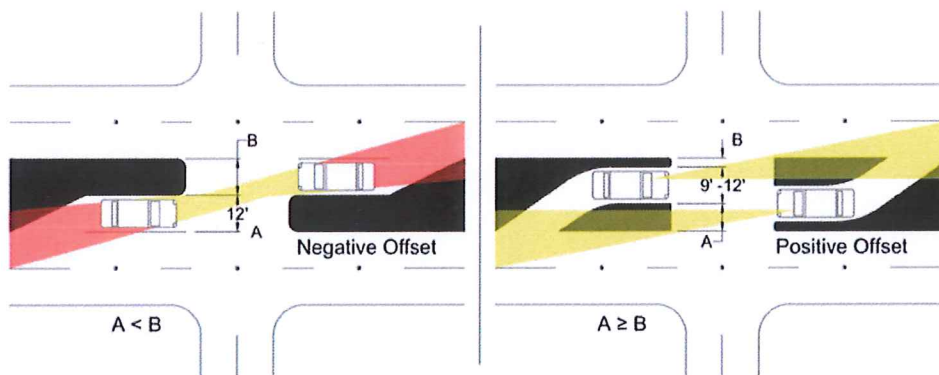
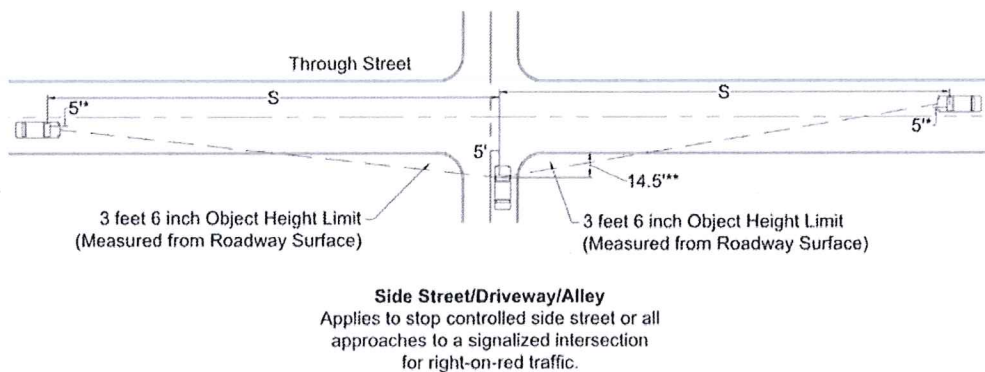


FIGURE 5-3.25 INTERSECTION DEPARTURE SIGHT DISTANCE REQUIREMENTS

Sight distance should be based on the design speed for the roadway. Design speeds for new roadways should conform to those identified in Section 5-3.100. Typically design speeds are 10 mph higher than the anticipated posted speed limit. The sight distance requirements outlined below are required for all private and public street intersections and at all intersections of driveways onto public or private streets. These standards do not apply to driveway intersections located on private property and that are internal to the private property and that do not intersect with streets.

Figure 5-3.29 depicts the technique used to determine the driver's eye location and an approaching vehicle; a line is then drawn to connect these 2 points. Continuous unobstructed line of sight must be provided along this line and throughout the approach to the intersection, providing an unobstructed sight triangle to the side street driver. Sight lines are to be drawn on roadway and landscaping plans to represent the areas that must be free of all objects and topography more than 2.5 feet above the adjacent roadway surface (edge of pavement); however, certain vegetation may be allowed. Vegetation placed within the sight triangle will be of a low height variety that remains below 2.5 feet when mature (measured from the roadway surface). Trees may be allowed within the triangle if the canopies are above 8 feet, they are a single trunk variety, and they are not spaced in a configuration that creates a "picket fence" effect.



* 5 feet measured to nearest lane line or centerline.

** 14.5 feet measured from face-of-curb or edge-of-travel way.

S = Intersection sight distance in feet on driver's left and right for right turns, left turns and through traffic.

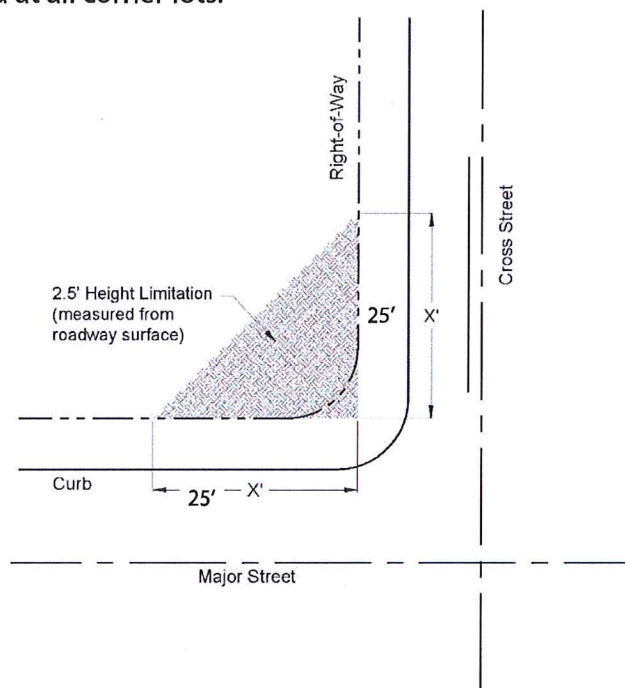
(See AASHTO Geometric Design of Highways and Streets for additional sight distance requirements)

(See, Appendix 5-3B for distance S)

FIGURE 5-3.26 INTERSECTION DEPARTURE SIGHT DISTANCE REQUIREMENTS

1. Intersection sight distance requirements are as follows:
 - a. Right-Angle Intersections
Right-angle intersections are those whose legs meet at an angle of 88 to 90 degrees. For these right-angle intersections the sight distances shown in and Appendix 5-3B are to be used with Figure 5-3.29 to calculate the sight triangle. Appendix 5-3B presents the sight distance requirements for varying roadway widths and design speeds for passenger cars, single unit trucks and combination trucks. If high volumes of truck traffic are anticipated, sight distances given in Appendix 5-3B will be used. Sight distances for vehicles turning left from the main street should also be considered and calculated based on the AASHTO Geometric Design of Highways and Streets.
 - b. Skewed Intersections
For skewed intersections where the intersection angles are less than 88 degrees, sight distances must be calculated in accordance with the procedures described in AASHTO's Geometric Design of Highways and Streets. Skewed intersection design must include appropriate design for pedestrian crossings and the location of curb ramps.
 - c. Intersections Within or Near a Curve
Sight distance measurements, identified in Figure 5-3.30 need to follow the curved street alignment when the intersection is within or near a horizontal curve.
2. Traffic Safety Triangles
Traffic Safety Triangles should be used to limit the height of structures, vegetation and other improvements on corner properties immediately adjacent

to all street intersections and where driveways intersect with streets. Safety triangles are not to be used as a substitute for intersection sight distance. Safety triangles provide additional visibility around corners for all intersection approaches and should be applied to the design of walls and landscape features. Fixed objects within the safety triangle cannot be taller than 2.5 feet measured from the adjacent roadway surface (edge of pavement); vegetation should be trimmed to 2.5 feet tall measured from the adjacent roadway surface. Figure 5-3.30 Traffic Safety Triangle on Corner Property depicts the method used to determine the safety triangle location. The safety triangle will follow the curvature of the roadway/right-of-way along curved roadway alignments. The sight distance requirements contained in both Figure 5-3.29 and Figure 5-3.30 are applied at all corner lots.



* If the standard right-of-way (46 ft. local residential, 60 ft. local collector) is not available, the safety triangle (X) shall measure 60 ft. on local residential streets and 70 ft. on local collector streets from the centerlines of the streets.

FIGURE 5-3. 27 TRAFFIC SAFETY TRIANGLE ON CORNER PROPERTY

3. Right-of-Way at Corners

A minimum of 25-foot radius or 25-foot by 25-foot triangle right-of-way shall be dedicated at street intersections to provide room for traffic control and sight distance.

E. Auxiliary Lanes

An exclusive turning lane permits separation of conflicting traffic movements and removes turning vehicles from the flow of through traffic. The requirement for an auxiliary lane may necessitate additional rights-of-way. Modifications to these requirements, including the storage and transition lengths may be allowed by the Transportation Department where the conditions do not allow the full design standard to be met.

1. Right-Turn Lanes

Right-turn lanes are required at all street intersections (public or private) on major arterials. Right-turn lanes may be required by the Transportation Department on minor arterial and collector street intersections. The lane lengths should be determined based on the anticipated turning volume and whether there is signalized or unsignalized traffic control. The standard vehicle storage length for a right-turn lane is 150 feet, with a 100-foot minimum length. Right turn lanes should be 11 feet wide. Refer to City of Scottsdale Standard Detail #2225 for taper and radius dimensions.

2. Left-Turn Lanes

Left-turn lanes are required at all street intersections on major collectors and arterials. Left-turn lanes may also be required at street intersections on minor collectors based on the projected left-turn volume and conflicting through volume. The lane lengths should be determined based on the anticipated turning volume and whether there is signalized or unsignalized traffic control. For left-turn lanes at signalized intersections, dual turn lanes should be considered when the turn volume exceeds 300 vehicles per hour, the opposing through volume exceeds 1,000 vehicles per hour, or the delay to left turning vehicles exceeds 45 seconds. Sight distance must be considered and calculated for these movements based on the AASHTO Policy on Geometric Design to determine the allowance of permitted left turns. Left-turn lane widths should be 11 feet however can be narrowed to a minimum of 9' to provide positive offset. Refer to Figure 5-3.28. Refer to City of Scottsdale Standard Detail #2225 for taper and radius dimensions.

3. Local Street Intersections with Major Streets

At intersections of local streets with major streets (Major Collectors, Minor Arterials, and Major Arterials) the pavement width shall widen to a minimum width of 36 feet to provide for a separate left turn. The 36-foot pavement width shall be provided for a minimum length of 100 feet from the right-of-way line with an appropriate taper length as approved by Transportation staff.

F. Median Design

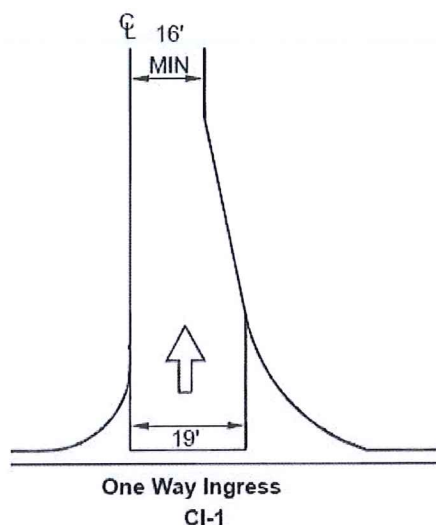
Raised medians are required on arterial streets and some major collector streets to separate traffic flows, channelize left turns and reduce conflicts. On most collector streets, flush or painted medians provide space between the through traffic lanes for left turning vehicles. Standard median widths are shown in Figure 5-3.31 through Figure 5-3.34. Variations to these standards may be approved through the master plan process or by the Transportation Department.

1. Raised Medians and Median Openings

Raised medians, where required, must be provided in accordance with the applicable city standard details, with the appropriate median width as noted above.

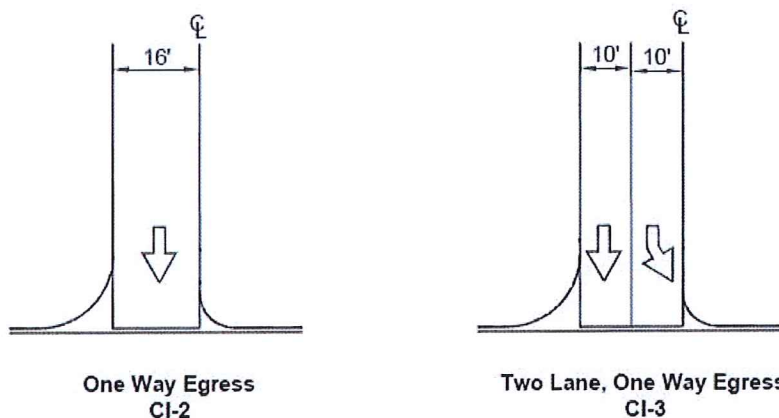
- a. Spacing and Location of Median Openings

If a street has a raised median, it is not possible to provide an opening in the median for every street intersection or driveway location. Full median openings should occur at not less than 1/4-mile intervals (1320 feet) on



*Note: Pedestrian ramps in this figure are illustrative only and should be designed and constructed per COS Supplement to MAG Details.

FIGURE 5-3.40 TYPE CL ONE-WAY INGRESS DRIVEWAYS



*Note: Pedestrian ramps in this figure are illustrative only and should be designed and constructed per COS Supplement to MAG Details.

FIGURE 5-3.41 TYPE CL ONE-WAY INGRESS DRIVEWAYS

DECELERATION LANES

The requirement for an auxiliary lane may necessitate additional rights-of-way. The standard storage length for a deceleration lane is 150 feet, with a 100-foot minimum length. Modifications to the design standard are allowed by the Transportation Department where the conditions do not allow the full taper or storage length. Deceleration lanes are required at all new driveways on major arterials and at new commercial/retail driveways minor arterials. Deceleration lanes for driveways may also

5-3.206

be required on collector streets and for non-commercial/retail driveways on minor arterials. The lane length should be based on the distance needed to allow the vehicle to exit the through lane and slow to a 15-mph travel speed. To determine the need for a deceleration lane on streets classified as a minor arterial or collector, use the following criteria:

- A. At least 5,000 vpd are expected to use the street;
- B. The 85th percentile traffic speed on the street is at least 35 mph;
- C. At least 30 vehicles will make right turns into the driveway during a 1-hour period.

Deceleration lanes may be required at driveways along collector and arterial streets that are at or over capacity to minimize the impacts to traffic flow along the adjacent street. They may also be required at driveway locations that cannot meet the standard driveway spacing to reduce the impacts of the separation from closely spaced streets and driveways.

The requirement for deceleration lanes may be subject to the Transportation Department review in urban areas and where conflicts with deceleration lane(s) exist.

BRIDGES, RETAINING WALLS, AND STRUCTURAL CLEARANCES

5-3.300

BRIDGES

5-3.301

A. **Bridge Roadbed Width**

The clear width of all bridges, including grade separation structures, needs to equal the full width of the physical improvements consisting of sidewalk, street, median and curb and gutter.

B. **Approach Guardrail**

If a vehicular railing or safety-shaped barrier is within the clear zone as defined by AASHTO Roadside Design Guide, approach guardrails are to be installed on all approach ends in accordance with AASHTO guidelines and the below paragraph, E. Railings.

C. **Cross Slope**

The crown is normally centered on the bridge except for one-way bridges, where a straight cross slope in one direction is used. The cross slope needs to be the same as for the approach pavement.

D. **Median**

On multi-lane divided highways, a bridge median that is 26 feet wide or less needs to be decked. The decking of all medians greater than 6 feet wide needs to be grated to allow natural light into the structure. Exceptions must be submitted to the Transportation Department for approval.

E. **Railings**

The length of the railing should be calculated as part of the design process. The railings to be used are the State of Arizona or State of California Department of Transportation standard design railings. There are four types of railings:

1. **Vehicular Barrier Railings**

The primary function of these railings is to retain and redirect errant vehicles.